

# Contents—Mar. 1939

Volume XX

No. 3

## ARCHIVES OF PHYSICAL THERAPY

DISRAELI KOBAK, M.D., Editor

Suite 712—30 North Michigan Avenue, Chicago, Illinois

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Subscriptions—In the United States, its possessions, and Mexico, \$5.00 yearly; Canada, \$5.50; elsewhere, \$6.50 the year.

Advertising rates on application. All advertising copy subject to acceptance by publication committee.

Published monthly at Chicago, Illinois, by American Congress of Physical Therapy. Entered as Second Class Matter January 29, 1938, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

### ORIGINAL ARTICLES

Relative Roles of Extremities in Body Heat Dissipation—Normal Circulation and Peripheral Vascular Disease.....Charles Sheard, Ph.D., Grace M. Roth, Ph.D., and Bayard T. Horton, M.D. 133

Discussed by Drs. Ben L. Boynton, Jessie Wright, Frank H. Krusen, William Bierman and Charles Sheard.

Ultraviolet Radiation in Gastro-Intestinal Tuberculosis.....John S. Coulter, M.D., and Leo L. Hardt, M.D. 143

Discussed by Drs. Morris Weisman, A. L. Banyai, John S. Coulter and Leo L. Hardt.

Wassermann-Fast Syphilis with Special Reference to Pyretotherapy.....James K. Howles, M.D. 149

Discussed by Drs. Elmer Hess, Walter Zeiter and L. Stadien.

Re-Establishment of the Circulation in Extremities.....William B. Kountz, M.D. 157

Diagnostic Procedures for Peripheral Vascular Disturbances.....Paul Merrell, M.D. 162

The Paraffin Bath in Peripheral Vascular Disease.....Samuel H. Sedwitz, M.D. 165

Papers by Drs. Harpuder, Kountz, Merrell and Sedwitz discussed by Drs. Geza de Takats, Madge C. L. McGuinness, Karl Harpuder, William Bryan Kountz, Paul Merrell and Samuel Sedwitz.

Certain Biologic Effects During Artificial Fever.....Michel Pijoan, M.D. 170

Discussed by Drs. William Bierman, Kenneth Phillips and Michel Pijoan.

Discussion: Chronic Myositis of Lumbar Region—H. B. Shorbe, M.D., by Drs. H. J. Behrend and John D. Currence ..... 174

### EDITORIALS

American Health Resorts and the Profession..... 175

### SPECIAL SECTION

Science, News and Comment..... 177

### THE STUDENT'S LIBRARY

Book Reviews ..... 181

### INTERNATIONAL ABSTRACTS

Abstracts from Physical Therapy, X-Ray, Radium and Biophysics ..... 185

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## RELATIVE ROLES OF EXTREMITIES IN BODY HEAT DISSIPATION—NORMAL CIRCULATION AND PERIPHERAL VASCULAR DISEASE \*

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and

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Physiologic and clinical investigations have shown that the exchange of heat between the body and its environment is of fundamental importance. The physiologic reactions involved are very different in nature in cold and hot environments. The studies which have been made during the past few years indicate that the unclothed or lightly clothed normal individual, in a recumbent position and in still air, exhibits normal physiologic regulation between air temperatures of 75 to 85 F. (24 to 30 C.). Above 85 F. or thereabouts, the individual adapts himself to the environment by sweating (zone of evaporative regulation). Below 77 F. (25 C.) the skin temperature falls, and the heat of the body tissues decreases more or less continuously (zone of body cooling).

The body adjusts itself to low environmental temperatures chiefly by vasomotor constriction of the peripheral blood vessels and to high atmospheric temperatures largely by an increase of sweat subsequent to maximal vasodilatation of the peripheral vascular system. The investigations of Burton,<sup>1</sup> Burton and Bazett,<sup>2</sup> and Winslow, Herrington and Gagge<sup>10, 11</sup> demonstrated that the physical regulation is due essentially, through the constriction or dilatation of blood vessels, to a change in conductivity over the gradient between environmental and internal body temperatures. Maddock and Coller,<sup>6</sup> and subsequently Herrick and Sheard,<sup>5</sup> showed that various portions of the body play relatively different roles in the elimination of heat, and that increasing the atmospheric temperature or increasing heat production causes a much greater shift of blood to the extremities than to other parts. In 1937, Sheard, Williams and Horton<sup>9</sup> reported the results of further investigations regarding the dependence of the dissipation of heat, in the zone of vasomotor control (68 to 83 F., or 20 to 28 C.), on the state of dilatation of the peripheral blood vessels and the relative roles of the upper and lower extremities in the control of heat elimination. It was pointed out that measurements of the skin temperatures of the fingers and toes serve as the most delicate and sensitive indicators of the changes in vasomotor tone of the superficial blood vessels, in order that the rate of heat production may equal the rate of heat loss, thereby maintaining constancy of the internal temperature of the body.

In this contribution we are presenting results which were obtained under environmental temperatures ranging from 18 C. (65 F.) to 34 C. (93 F.), regarding: (1) the relative roles of the upper and lower extremities, as evidenced by skin temperatures of the fingers and toes, in the dissipation of heat from the body; (2) the effects of changes of relative humidity with various atmospheric temperatures on the temperatures of the extremities; (3) the thermal changes produced in the extremities by the ingestion of food; (4) the relationship between the temperatures of the toes and the basal metabolic rates

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\* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 14, 1938.

obtained at 25 C.; (5) cooling and warming rates of the toes, and (6) comparison of the data obtained on subjects with normal circulation to the skin temperatures of individuals with peripheral vascular disease.

### Experimental Standards

It is necessary that there be satisfactory control and regulation of the atmospheric conditions, the person under test, and the physical methods for the measurement of cutaneous temperatures. Details regarding the control of temperatures and humidities, thermocouples and the measurement of skin temperatures are given elsewhere.<sup>8</sup> Air movement was confined to 15 to 30 feet per minute. The subjects wore lightweight pajamas or shorts and remained in the horizontal position (slightly elevated) on a comfortable bed from 9 a. m. to 5 p. m. As pointed out by Freeman and Linder,<sup>4</sup> it is essential that the body remain under any given atmospheric condition for a hour or so, or until fairly constant temperatures of the extremities (particularly of the toes) are obtained. Roth, Williams and Sheard<sup>7</sup> investigated the effects of posture on the temperatures of the fingers and toes. Hence, the maintenance of the subject in the horizontal position and the ability to move the bed, subject and thermocouples as a unit, when it is necessary to change from one to another environment, have contributed greatly to the accuracy of the experimental data.

*Skin Temperatures of the Normal Subject.*—In clinical investigations regarding functional or organic involvement in the upper or lower extremities, and the thermal changes that may be produced by the administration of typhoid vaccine, by increased production of heat through the ingestion of food, or by increases in atmospheric temperature, it is necessary to know the relative values of the temperatures of the fingers and toes of healthy individuals with normal basal metabolic rates, normal dryness of extremities, lightly clothed and in the horizontal position under standard conditions. Numerous tests have shown that 25 C. (77 F.) and 40 per cent relative humidity are satisfactory. Under these conditions, the superficial temperatures of the forehead, thorax and extreme upper portions of the arms and legs are commensurate in value and lie between 32 C. (89.5 F.) and 35 C. (95 F.). There is, however, a temperature gradient along the extremities, the toes showing the lowest temperature.

In general, under standard environmental conditions (77 F. and 40 per cent humidity), the temperatures of the toes will be slightly above room temperature. The forehead, thorax and upper portions of the legs are 7 to 10 C. warmer than the toes. Since the temperature of the skin in any area is the resultant of the heat brought to it largely by its blood supply and the heat dissipated from its surface, there is a marked but normal vasoconstriction of the peripheral vessels of the feet (as is indicated by the relatively low temperature of the toes) which is operative to conserve the heat of the body. In contrast to this condition, however, the temperatures of the fingers ordinarily lie within the range of 32 to 35 C. Hence there is evidence of very considerable vasodilatation of the peripheral vessels of the fingers. Under the standard environmental conditions, therefore, the finer adjustments or regulations of the dissipation of heat are controlled by the vascular supplies to the hands and fingers. These relationships are illustrated by the curves of figures 1 and 2.

*Effects of Various Environmental Temperatures.*—The relative role of the upper and lower extremities as indicated by skin temperatures of the fingers and toes, in the regulation of the loss of heat from the body, has been investigated on several individuals with normal circulation under environmental temperatures which have been increased by increments of 1 to 2 C. from approximately 18 C. (64.5 F.) to 34 C. (93.2 F.). The relationships between the temperatures of the toes and fingers and of the room temperatures for three persons, whose basal metabolic rates were 40.7 (subject A) 36.4 (subject B) and



35.1 (subject C) calories per square meter per hour, are shown in figure 2. The range of variation in temperatures of the fingers and toes occurred in each instance during a period of four to six hours' exposure to the specified atmospheric temperature, the relative humidity being maintained at 40 per cent.

Under atmospheric conditions ranging from 18 C. (64.5 F.) to 22 C. (71.5 F.), the temperatures of the toes are, in general, at or near that of the room, while increased vasodilatation is occurring in the upper extremities as is indicated by the rise in temperature of the fingers. The temperatures of the

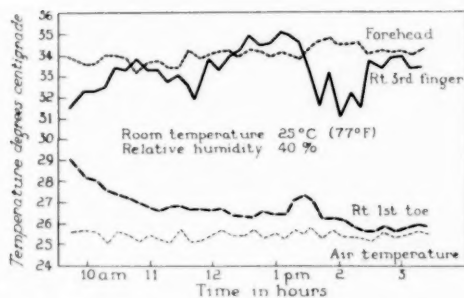


Fig. 1. — Curves of skin temperature of the forehead, a finger and a toe of a normal subject in the basal state in an environmental temperature of 77 F. (25 C.) and 40 per cent relative humidity.

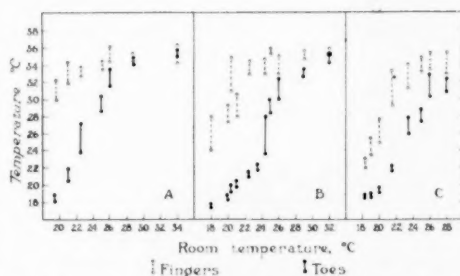


Fig. 2. — Curves showing the relative roles of the upper and lower extremities, as indicated by the skin temperatures of the fingers and toes of normal subjects under a range of environmental temperatures extending from 18 C. (65 F.) to 35 C. (94 F.). Basal metabolic rates, calories per square meter per hour: Subject A, 40.7; B, 36.4, and C, 35.1.

toes exceed the environmental temperature when the fingers reach 33 to 35 C. (91.5 to 95 F.). This ordinarily occurs at a room temperature of 25 to 26 C. Further increase of the environmental temperature produces little, if any, change in the temperatures of the fingers, while the temperatures of the toes increase rapidly and reach a value comparable to those of the fingers under an atmospheric state of 28 C. (82.5 F.) to 29 C. (84 F.). Hence, in normally reacting subjects, as the environmental temperature is increased, the regulation of the loss of heat is taken care of, initially, by the hands and lower portions of the arms, since normal vasoconstriction of the lower extremities is present (zones of body cooling or heat storage, and vasomotor regulations). This is followed by regulatory control largely on the part of the feet and lower portions of the legs, when the room temperature reaches 25 C. (zone of vasomotor regulation). Finally, at higher environmental temperatures (28 C. to 30 C. or 82.5 to 86 F.) the temperatures of the toes and fingers closely approximate those of the forehead and thorax. At temperatures exceeding 31 to 32 C., maximal vasodilatation of peripheral vessels will be maintained, peripheral blood flow will increase proportionately with the temperature, and the internal temperature of the body will be kept approximately constant by increases in secretion of sweat (zone of vasomotor and evaporative regulation).

*Temperature Changes in Relative Humidity.* — It was of interest to determine whether changes in relative humidity, in the range of dry bulb readings from 22.8 C. (73 F.) to 27.3 C. (82 F.), produced any appreciable change in the temperatures of the fingers and toes of two normal subjects with basal metabolic rates of 44.5 and 39.2 calories per square meter per hour. The range of air temperatures from 73 to 82 F. was chosen because the loss of heat due to evaporation (frequently referred to as insensible loss) is nearly constant, and the subjects reported comfort except for slight chilliness of the feet at the lowest dry bulb reading. The temperatures of the forehead ranged from 33.5 to 35.2 C. The data of table 1 show that there is little if any effect produced on the skin temperatures of the fingers and toes by changes in the relative humidity at any designated atmospheric temperature. Any minor changes

TABLE 1.—*Data Concerning the Effects of Various Environmental Temperatures and Ranges of Relative Humidity at Any Designated Dry-Bulb Reading on the Temperatures of the Forehead, Fingers and Toes.\**

Environmental Conditions		SUBJECT A Average Temperature C.			SUBJECT B Average Temperature C.		
Dry-Bulb Temperature	Relative Humidity (Average Value) Per Cent	Forehead	Fingers	Toes	Forehead	Fingers	Toes
73 F. (22.8 C.)	38	33.8	31.0	24.5	34.7	32.0	23.8
	53	33.5	29.5	23.4	34.5	31.0	23.2
	68	34.2	28.5	23.6	35.2	30.5	23.4
75 F. (23.9 C.)	41	34.2	35.5	32.5	35.6	34.5	32.0
	54	34.3	34.7	31.6	35.2	35.0	30.8
	64	34.7	33.8	29.6	35.0	33.8	28.4
77 F. (25 C.)	39	33.6	34.5	29.3	33.5	34.0	29.8
	58	34.1	33.8	28.5	34.5	33.5	27.2
	70	34.5	32.5	27.3	34.8	31.8	26.8
79 F. (26.1 C.)	32	34.5	35.5	32.2	34.5	34.6	32.5
	50	34.8	35.5	31.5	34.8	34.7	31.6
	64	35.3	34.3	29.8	35.2	35.0	31.1
82 F. (27.2 C.)	30	34.5	34.6	33.6	35.3	35.0	33.2
	53	35.1	35.0	32.8	35.0	35.5	33.5
	66	35.2	35.0	32.5	35.4	35.4	33.4

in skin temperature which might be produced are concealed in the relatively large thermal changes in the extremities due to small changes in atmospheric temperature. These findings are in agreement with the work of Burton<sup>1</sup> and the more recent contributions of Winslow, Herrington and Gagge,<sup>10</sup> in which different procedures were used.

#### Effects of Increased Heat on Skin Temperatures of the Extremities

An increase in the production of heat in the normal, resting subject may be occasioned by a higher basal metabolic rate or by the increase of metabolism through the ingestion of food. Details regarding the changes in temperatures of the fingers and toes and the relative roles of the upper and lower extremities in the dissipation of heat, when an increased production of heat occurs through the ingestion of food, were reported by Sheard, Williams and Horton.<sup>9</sup> In order that the data of thermal changes in the skin of a normal subject subsequent to the ingestion of food may be available for comparison with similar data obtained for a person with peripheral vascular disease, a representative set of records is given in figure 3. In the data plotted from 9 a. m. to 1 p. m. it is evident that, with the subject in the basal state and in an environmental temperature of 25 C. (77 F.), the temperatures of the fingers and forehead were approximately 34 to 35 C. The toes were near room temperature. These temperatures of the fingers and toes indicate approximately maximal peripheral vasodilatation in the upper extremities, with normal vasoconstriction in the feet and lower portions of the legs. If, therefore, the production of heat is increased, the regulation of the loss of heat should be assumed by the lower extremities, and the changes in the temperature of the toes should vary somewhat commensurately with the changes in the rate of heat production. This is shown in figure 3 by the considerable rise in the toes (from 26 to 33 C.) in the course of three hours after ingestion of a standard meal.

That there is a close correlation between the temperatures of the extremities and the mechanism for the dissipation of heat is shown, according to Maddock and Collier,<sup>3,6</sup> by the fact that, under constant environmental conditions,

\* Basal metabolic rate (taken at dry-bulb temperature of 77 F. and relative humidity 40 per cent): subject A, —2 (44.5 cal/square meter/hour); subject B —10 (39.2 cal/square meter/hour).

The data tabulated for any given dry-bulb temperature and range of relative humidities were obtained on the same day on both subjects. The two subjects, remained under any given environmental temperature and relative humidity for a period of 2 to 3 hours.

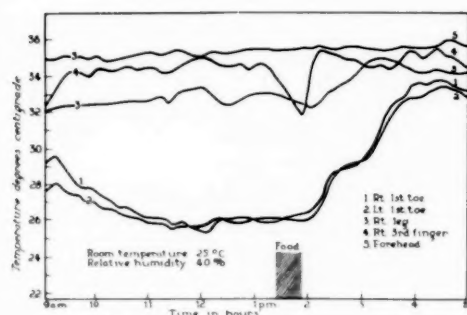


Fig. 3.—Curves showing the time-temperature relationships of the forehead, upper leg, fingers and toes of an individual with normal circulation, before and after ingestion of food. Curves 1 and 2, which show the temperatures of the toes, indicate the role of the lower extremities in the dissipation of heat subsequent to the increase in heat production in an atmospheric environment of 25 C. (77 F.).

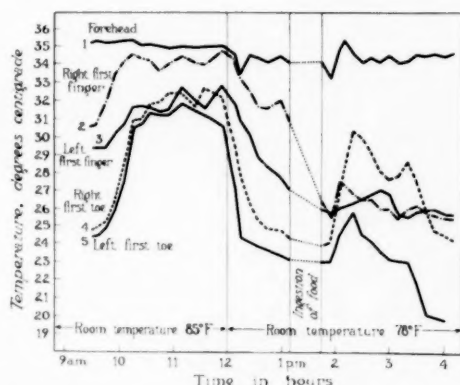


Fig. 4.—Raynaud's disease. The peripheral arteries pulsated normally. Curves illustrating complete vasodilatation of the fingers and toes in an environmental temperature of 85 F. (29 C.). Marked vasoconstriction followed promptly after the subject was moved to an environmental temperature of 78 F. (25 C.), and there was little change of the surface temperature of the fingers and toes subsequent to the ingestion of food.

a simple linear relationship exists between the temperature of the great toes and the basal heat production per unit of surface area. The data on which this conclusion is based are rather meager and open to some criticism. We have found a rather wide scatter of points which arrange themselves along two straight lines. This indicates the presence of a linear relationship of a dual character between the average temperatures of the toes and the basal metabolic rates which were obtained in both instances under an atmospheric temperature of 25 C. and 40 per cent relative humidity. It is difficult to explain this two-fold linear relationship, since there is no connection between sex (all subjects were male), season of the year or other factors of this character.

*Cooling and Warming Rates of the Extremities.*—There is relatively little change in the temperatures of the forehead, thorax, arms and upper portions of the legs when the normal subject in the basal state is moved from an environmental temperature with which he is in equilibrium (*e. g.* 26 C.) to a cooler atmosphere (*e. g.* 18 C.). In contrast, there is a decided cooling of the toes. Constancy of temperature, approximately that of the room, is reached in about an hour and a half to two hours. When the subject in turn is moved from an 18 C. (65 F.) temperature to an environment of 34 to 35 C. (approximately 94 F.), the thermal changes in the toes are most pronounced. The rise in temperature is at first rapid; this is followed by a gradual change as the temperature of the toes approximates a maximal value of 35 C.

The rate of warming or cooling of the tissue should be proportional to the difference between the temperature of the tissue and its surroundings. This relationship may be written as

$$T_t = T_0 e^{-at}$$

in which  $T_0$  is the initial (arbitrarily chosen zero time) difference in temperature.  $T_t$  is the difference in temperature at any specified time,  $t$ , and  $a$ , is a constant. It follows that

$$a = -\frac{1}{t} \log_e \frac{T_t}{T_0}$$

The data obtained on a group of normal persons were subjected to mathematical analysis. The results showed that the rate of cooling of the toes, in each instance, was a constant and that the range of rates of cooling was be-

tween 0.02 and 0.05 C. per minute. Similar rates were found for persons with peripheral vascular disease. Since rates of cooling lie within the same range for either normal or abnormal circulatory conditions, it follows that corresponding changes are present in the supply of blood brought about by vasoconstriction, and that the same order of change exists in the temperature gradient between the deeper and superficial tissues.

In contrast, however, to the approximate constancy of rate of cooling of tissue (toes), we found that there are two (and possibly three) distinct rates of warming which fall within the range of 0.015 to 0.15 C. per minute. The initial rate of warming of subjects with normal circulation is a constant in each individual. The initial rates lie between 0.015 and 0.03 C. per minute and are constant, *per se*, until the temperatures of the toes reach a value of about 28 C. (80.5 F.). This is a definite change in the rates of warming, ranging in normal individuals between 0.04 and 0.10 C. per minute, when the temperatures of the tissue (toes) exceed 27 or 28 C. Accordingly, the initial rate of warming represents the rate of heating of tissue only brought about by the environment; the second rate shows the combined effects of the heating of tissue by the environment and the increased supply of blood. The change of rate of warming under environmental temperatures of about 28 C. is in agreement with the findings regarding the regulatory control of the dissipation of heat, which is assumed initially by the lower extremities when the toes register 25 to 27 C.

In conditions of abnormal vasoconstriction (spasm) or organic occlusion, it is found that the rates of warming of tissue by the environment are approximately the same as in normal circulation, but that there are abnormally low or definitely decreased rates of warming in the range of difference of temperature between environment and tissue in which vasodilatation occurs normally.

### **Skin Temperatures of Extremities in Peripheral Vascular Disease**

We have above considered in some detail the important role of the extremities in the dissipation of heat from the body under various atmospheric conditions and in various physiologic states. An increase or decrease of skin temperature is indicative of a corresponding change in the supply of blood to the peripheral tissues. These changes in blood supply are controlled by the vasomotor system.

A comparison of the data and information obtained regarding the regulatory functions of the extremities in the dissipation of heat with the similar data in peripheral vascular disease, is of considerable importance to the medical profession both from the standpoint of diagnosis and treatment. Furthermore, these data are of significance to physical therapists and to engineers because, under certain environmental conditions, release of abnormal vasoconstriction and a betterment of circulatory conditions may be accomplished, in some measure at least, in many individuals as well as affording added comfort.

Peripheral vascular disease may be classified in two main divisions: functional diseases of which Raynaud's disease is an example of the vasoconstricting type, and organic diseases of which thrombo-angiitis obliterans is an example. Raynaud's disease is caused by vasospasm, whereas thrombo-angiitis obliterans represents an occlusive arterial disease of the extremities in which some degree of superimposed vasospasm is usually present in the collateral vessels, especially in the early course of the disease. In advanced cases, vasospasm is frequently absent. In individuals with peripheral vascular disease, as in normals, the processes of dissipation of heat by radiation should occur but with some limitation which is imposed by reason of the inability of the blood vessels to contract or to dilate.

Representative sets of data regarding the skin temperatures of the fingers and toes in Raynaud's disease, thrombo-angiitis obliterans (Buerger's disease) and essential hypertension are given in figures 4, 5 and 6. The data given in the curves should be considered as illustrative of the marked differences in findings in these conditions, when compared with the skin temperatures of subjects with normal circulation under a corresponding environment.

*Raynaud's Disease.* — As is shown in figure 4, the temperatures of the fingers, in an atmospheric environment of 25 C. (77 F.), are several degrees below the temperatures of the forehead and, in the course of two hours' time, assume values which are 1 to 3 C. above room temperature. The temperatures of the toes are about 3 C. below room temperature and remain so throughout the course of the day. Under similar environmental conditions, a normal person exhibits skin temperatures of 34 to 35 C. in the fingers, those of the toes being, at, or slightly above, room temperature. The ingestion of food during the day caused little if any rise in the fingers and had no effect on the feet and lower portions of the legs. The hands and feet are cold and moist to the touch. There is evidently considerable involvement of both upper and lower extremities

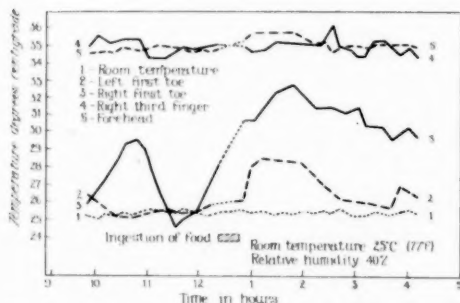


Fig. 5. — Buerger's disease. Curves of skin temperatures of the forehead, fingers and toes; both femoral arteries pulsated normally, but no pulsations were present in the popliteal arteries, the posterior tibial arteries or the left dorsalis pedis artery. The right dorsalis pedis artery was occluded 50 per cent. An adequate collateral circulation had been established in the right lower extremity, but the patient had marked circulatory insufficiency in the left lower extremity. Hence, good vasodilatation occurred in the right first toe, but to a much less extent in the left first toe following ingestion of food.

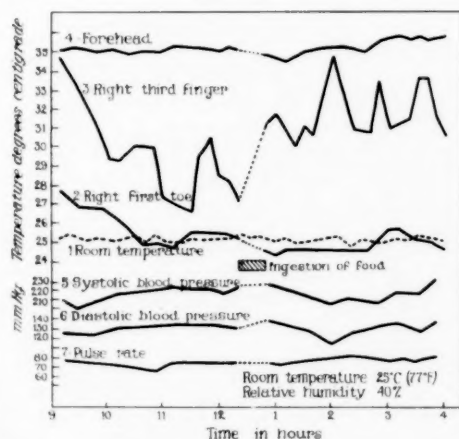


Fig. 6. — Essential hypertension group 2 type. Curves showing the time-temperature relationships of the forehead, fingers and toes in an environment of 25 C. (77 F.). The temperatures of the fingers and toes indicate abnormal vasoconstriction. The blood pressure and pulse remained practically constant.

and, since pronounced vasoconstriction is present, the regulation of the loss of heat is accomplished in considerable degree by evaporative processes.

When an individual of this type is placed in a warmer environment (*e. g.* 85 F. or 30 C.), the temperatures of the toes generally exceed the environmental temperature. The fingers may or may not be warmer than the toes, dependent on the degree of spastic involvement.

*Buerger's Disease.* — The curves of figure 5 show that the toes are at, or slightly below, room temperature (25 C.) when in the steady state; the temperatures of the fingers and forehead being approximately 34 C. Following the ingestion of food there is a rise of temperature of a few degrees of the left foot as compared to a rise of about 7 C. of the toes of the right foot. It is apparent that the amount of involvement is greater in the left lower extremity. In general, it has been found that the thermal changes of the toes in cases of thrombo-angiitis obliterans subsequent to the ingestion of food are virtually the same as those obtained after the administration of typhoid vaccine, if allowance is made for the rise of rectal temperature produced by the vaccine.



*Essential Hypertension.*—In an individual with essential hypertension (fig. 6) of 210 mm. of mercury systolic and 130 mm. of mercury diastolic pressure, there is abnormal vasoconstriction of the upper extremities, as is shown by the low and fluctuating skin temperatures of the fingers. After ingestion of food the toes remain at room temperature with some rise in, but spasmodic control of, the temperatures of the fingers. In individuals of this type there will be very appreciable vasodilatation of the extremities when the atmospheric temperature is raised to 30 C. (85 F.). Under these environmental conditions the temperatures of the fingers approximate those found in normal subjects. There will be considerable vasodilatation of the lower extremities, although the temperatures of the toes may be several degrees below the normal values in corresponding air temperatures.

*Effects of Environmental Temperature.*—As we have implied, it is possible to determine the atmospheric temperatures at which the extremities may exhibit some degree of vasodilatation in peripheral vascular disease. The temperatures of the toes under the standard environmental temperature of 25 C. may vary from values several degrees below to values at or above the surroundings. The temperatures of the fingers in different individuals range from normal values (32 to 34 C.) to temperatures indicative of pronounced vasospasm of the peripheral vessels of the upper extremities. Atmospheric temperatures may be found under which considerable dilatation of the peripheral vessels occurs in functional vasospasm. In general there will be corresponding changes in the temperatures of the toes commensurate with the values found in normal subjects, although conditions are encountered in which there is evidence of tissue heating with but little vasodilatation of the blood vessels. In organic occlusion of the lower extremities with some superimposed spasm, environmental temperatures may be established in which the lower extremities will be normally dry and in which the temperatures of the toes will be above the atmospheric temperature, thereby indicating increased blood supply. This range of environmental conditions varies with the degree of vasospasm, but may be set at from 27 C. (81 F.) to 30 C. (86 F.).

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### Discussion

**Dr. Ben L. Boynton**, (Madison, Wis.): This paper and the scientific exhibit illustrative of the data presented here by Doctor Sheard and his associates constitute a most impressive bit of research. Such a presentation leaves little room for discussion but is distinctly thought provoking as to the possibilities presented by the procedures he has described.

I should like to ask Dr. Sheard, first, if he has any explanation, either anatomical or physiologic, of the temperature gradients he has so carefully noted to exist between the thorax and the distal portions of the extremities? Second, is there any explanation of the observation that the fingers respond before the toes when the subject is placed in a warmer environment and that the reverse seems to occur when the subject is placed in a cooler environment? Third, does Dr. Sheard have any information concerning the peripheral vascular state in relation to the reaction of patients suffering from atrophic arthritis?

**Dr. Jessie Wright** (Pittsburgh, Pa.): After hearing the paper by Drs. Sheard, Williams and Horton, one cannot help but be impressed by the scientific value of their contribution. The care with which all phases of the experiments were controlled makes this research a trustworthy foundation for a much needed analysis of normal findings from which the pathologic state may be defined. We are told that under standard conditions of 25 C. and 40 per cent relative humidity with a normal subject in the basal state, the forehead, thorax, upper legs and arms are 7 to 10 C. warmer than the toes which are maintained at nearly constant level close to that of room temperature. Vasoconstriction indirectly shown by the relatively low temperatures of the toes suggests a mechanism for conserving body heat. Material presented by the authors tonight and study of the charts found elsewhere in the section of Scientific Exhibits have shown evidence that the finer adjustments or regulation of the dissipation of heat are controlled by the fingers and lower portions of the arms, indicated by a rhythmically fluctuating temperature of the fingers.

It is interesting to note that in normally reacting subjects, as the temperature of the room is increased, the regulation of the dissipation of heat is accomplished initially by the hands and lower arms, to be followed by a regulatory control on the part of the feet and lower legs when the room temperature reaches 78 F. Finally, at higher temperatures, (85 to 90 F. with relative humidity of 40 per cent) the temperatures of the fingers and toes closely approximate the temperatures of the forehead and trunk. Thus we have been shown that it is possible definitely to determine the environmental conditions under which

the upper and lower extremities respectively begin to function as regulators of dissipation of heat from the body.

In this report, the modifications by rate of heat production, by the presence of moisture, and by ingestion of food are made available to us in specific terms. The surface temperature changes noted in these experiments are also of interest to us clinically as indications of changes in the blood flow and circulation. The rate of cooling or warming of tissues was found related to the differences between the temperature of the tissue and its surroundings. The characteristic changes normally found in certain temperature ranges show that within a rather wide variation of environmental temperatures normal vasoconstriction takes place, and the term vasospasm should be avoided in this relation. The precision of the investigations of the authors gives us a basis for recognizing normal, and from that the degrees of abnormal states of the peripheral circulation and the vasomotor system.

**Dr. Frank H. Krusen** (Rochester, Minn.): I think it is interesting to note that this study represents a particularly large amount of labor. Aside from all the long hours that Dr. Sheard spent on the analysis, I know that his associate, Dr. Williams, spent eighteen months, day in and day out, swinging thermocouples every ten minutes, dozens and dozens of them, and I imagine the number of thermocouple readings totals almost in the millions, does it not, Dr. Sheard? This is a piece of work that took eighteen months so far as Dr. Williams is concerned and a considerable longer time so far as Dr. Sheard is concerned.

**Dr. William Bierman** (New York): Dr. Sheard showed very clearly how extremities act like sluice gates in safeguarding the internal temperature of the body. Whenever that internal temperature level is threatened, as by changes in environmental temperature or by changes produced by metabolic activity after ingestion of food, he has shown very clearly how the vascular responses of the skin of the extremities comes into action in order to safeguard this level.

There are many things which can be said about the numerous considerations to which he has invited your attention. I should like to ask him two questions. One is this: Whether when placing the thermocouples on the skin surface and retaining them under a cuff (such as a piece of tape if tape be the material employed for the purpose) this procedure might make some difference in the correct evaluation of the recorded temperatures. The second question refers to the changes which he has noted after the ingestion of food. Was the subject given his food by some attendant or did he help

himself. Also, was the temperature of the food colder or hotter. I should like his views on the second question particularly, because I observed in one of his slides, where he calls attention to the changes occurring in the case of Buerger's disease, that the temperature of the fingers of the right hand went up after the ingestion of food while the temperature of the fingers of the left hand was not altered. I wonder whether such motion occurred, and was associated with a voluntary muscular activity in bringing the food to the mouth. If the individual were a right-handed one, and drank some hot coffee or warm tea, this action might be a factor to influence temperature changes. It is interesting to observe, as you probably did, that where the temperature of the toe or of the finger on both sides are indicated the temperatures of these surfaces do not run parallel. We are both impressed by the fact that just as the two halves of the body do not appear to be exactly alike in their configuration, so there may be some physiologic differences between the two sides of the body.

**Dr. Charles Sheard** (closing): In reply to the first two questions of Dr. Boynton, I have to say that I have no explanations, either anatomical or physiological, for the gradients which exist and for the relative roles played by the extremities in the control of the dissipation of heat from the body. The material which I have presented contains the results of what may be called a fact-finding investigation, carried out under controlled conditions of subject and environment. We all hope that some answers or, at least, leads or suggestions looking toward answers to Dr. Boynton's queries, will be forthcoming.

I am taking a few extra minutes to describe briefly a case of essential hypertension in which the temperatures of the toes were three or four degrees Centigrade below room temperature (77 F. or 25 C.) and in which the upper extremities evidenced some vasoconstriction and erratic control of the dissipation of heat as indicated by the temperature of the fingers. After bilateral splanchnic sympathectomy, the subject being in the metabolic state and in an atmospheric environment of 25 C., there was an interchange of functions of the upper and lower extremities. After operation, the temperatures of the toes were high and commensurate with those of the forehead and thorax (31 to 34 C.). The fingers, on the other hand, were very low in temperature; as a matter of fact they were from 1 to 3 C. below room temperature. This complete reversal of temperature relationships of the upper and lower extremities subsequent to bilateral splanchnic sympathectomy is rather striking, and has been found to occur in a few cases only after operative interference of the character mentioned.

With reference to physiologic reactions to environment on the part of subjects

with atrophic arthritis, I have to say that, during the past ten years several investigations have been carried out and it has been found that this class of patients responds in all particulars about the same as normal subjects.

In reply to Dr. Bierman I wish to point out that comparative data on temperature measurements by the use of thermocouples, radiometers and thermometers have been made by several investigators. We may mention the work of Aldrich, Bedford and Warren, and the more recent researches of Hardy in the laboratories of Professor DuBois. There is a difference in the skin temperatures obtained by these three instruments. However, if the thermocouples are properly made and applied, the difference between readings by radiometers and thermocouples is less than one degree Centigrade. In our investigations, we were not interested in partitioned calorimetry, but rather in a determination of skin temperatures over a period of time (two to three hours) under various environmental temperatures, metabolic states and so forth, in normal individuals and in subjects with peripheral vascular diseases. In other words, we have been concerned with levels or changes in levels of skin temperature under specified and controlled environmental temperatures. The ability to leave the thermocouples in place, especially when the subject has been moved from one set of atmospheric conditions to markedly different conditions, has been an important asset in our investigations.

Throughout all these investigations we endeavored to make the subject very comfortable and to do everything possible to induce a minimum of movement. A change of posture for a relatively short period of time (i. e. half an hour) has an effect on the temperatures of the fingers or toes, dependent on the character of change of posture. In general, the subjects enjoyed reading, so arrangements of a satisfactory support and overhead lighting were made in order to induce a minimum of movement and restlessness. Several sets of data were taken, over a period of two hours in each instance, when the subject was as quiet as possible and, again, when the subject was fairly restless. Very minor changes in temperature were obtained unless the hands were pendent, subject lying on the side and with one arm under, or legs crossed.

The food was practically at body temperature. Hot or iced drinks were avoided. The water consumed was generally at room temperature (77 F.) and ordinarily no water was given except at the time of the ingestion of food. The intake of a pint of water at 10 C., the patient being in the basal state and in an environment of 80 F., causes pronounced vasoconstriction in the lower extremities, as shown most markedly by the toes, generally accompanied by a definite reduction in the temperatures of the fingers.

## ULTRAVIOLET RADIATION IN GASTRO-INTESTINAL TUBERCULOSIS \*

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and

LEO L. HARDT, M.D.

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The application of heliotherapy for many pathologic conditions on an empiric basis dates back to antiquity. The modern utilization of natural ultraviolet rays for the treatment of extrapulmonary tuberculosis has been placed on a rational basis by two Swiss pioneers, Bernhard and his disciple Rollier, through their prolonged critical observations of the largest series of cases recorded in the literature. It is today generally acknowledged that the labors of these surgeons have given the impulse to an extension of this form of therapy throughout the world. Clinical observations both here and abroad have demonstrated the therapeutic value of both natural and artificial ultraviolet radiation as an adjunct in the management of tuberculosis of the gastro-intestinal tract.

The literature on this subject is replete with data confirmatory of our own clinical experience, to the effect that the major trend of this grave disease, namely, pain, distention and diarrhea, is favorably influenced in the majority of cases.

Thus Brown and Sampson<sup>1</sup> observed:

Of 360 patients of intestinal tuberculosis treated with artificial heliotherapy, 18 per cent did not obtain any benefit, 33 per cent were slightly or considerably helped, 25 per cent were markedly benefited, and 24 per cent (86) patients were apparently cured of their secondary intestinal tuberculosis. The rarity of relapse and the pathologic evidence both testify to the curability of this dreaded complication. We do not deny that other methods of treatment may be more effective than the artificial heliotherapy that we have used in many cases ten or more months, but nowhere in medical literature, as far as we can discover, are there recorded so many recoveries from secondary intestinal tuberculosis, accurately diagnosed as are here reported.

Smithies, Weisman and Fremmel<sup>2</sup> believe that in some instances, various forms of heliotherapy appear to have value in relieving pain and in promoting general comfort. They were not yet ready to subscribe to the opinion that heliotherapy has any curative influence on the intestinal lesions in tuberculosis.

Du Mortier<sup>3</sup> states:

By far the most favorable method of treatment is in the use of ultraviolet light. The results, controlled both by clinical observations and by roentgenographic examination, can only be described as remarkable. The various symptoms of intestinal tuberculosis frequently disappear within two or three months, and in certain cases the roentgenographic signs of irritable bowel which were obvious at the first examination disappeared and the bowel ulcers appeared to be healed. The technic commonly employed is empirical at present. The most favorable dosage is not known.

Davis<sup>4</sup> believes that the favorable influence of general (rather than local) irradiations by the actinic rays produced by the mercury quartz vapor or carbon arc lamps are extremely gratifying. However, reliance upon this form of treatment without emphasis being placed upon the need of bed rest is not justified. When the two are combined, improvement may confidently be expected, except

\* Aided by grants from the Council on Physical Therapy, American Medical Association, and Chicago Municipal Tuberculosis Sanitarium.

<sup>4</sup> Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 14, 1938.



in the near-terminal group. Abatement of symptoms and lessening of x-ray evidence of spasm and hypermotility may be expected in three to six weeks. The lessening of discomfort caused by excessive gas in the intestinal tract, which is often the only symptom present, is most frequently the first sign of improvement. He believes that many times it is desirable to utilize ultraviolet ray therapy in the patient's home. The increased popularity of the carbon arc lamp in the last few years is ascribable to its therapeutic value. Natural heliotherapy, except in those instances where there is no pulmonary tuberculosis, is emphatically contraindicated.

Kline<sup>5</sup> affirms that his observation and experience have forced him to the opinion that open air exposure to sunlight is the best form of ultraviolet irradiation in the treatment of this form of tuberculosis.

Brown and Sampson<sup>6</sup> in 1932, reiterated their earlier statement of 1927 and stated: "Heliotherapy, natural or artificial, relieves the symptoms in a large proportion of early cases. In a certain number apparent recovery follows its use. When desired results are not obtained by this method, roentgen or other forms of treatment should be carefully followed."

McLaughlin<sup>7</sup> discussing heliotherapy and high vitamin diet states that these two methods are closely allied in that they both aim at an increase in the supply of certain vitamins to the body and thus at raising its resistance to infection and also at stimulative healing. He notes that pain, nausea, and vomiting are quickly relieved, and to a certain extent also diarrhea and digestive disturbances. The effect on symptoms is greatest and more rapid when the treatment is started soon after their onset.

Erickson<sup>8</sup> states:

One of the major therapeutic measures used has been the ultraviolet light. Most sanatoria use it and believe it has at least some value. I made a study of 81 cases some years ago at Saranac Lake. These had both positive x-ray evidence and symptoms of intestinal tuberculosis and were treated with ultraviolet light. I am perfectly aware that it can be said these cases were survivors and therefore selected, but the results were at least highly suggestive and justify such treatment unless something better is found: 24.7 per cent had entire relief of symptoms; 47 per cent were very much improved; 13.5 per cent were less though definitely improved; 14.9 per cent were unimproved. Some symptomatic improvement occurred in 85 per cent for an average of from 12 to 18 months after symptoms ceased.

Brown's figures of 180 cases in Saranac Lake showed that of those treated with ultraviolet light 65 per cent were alive, of 29 not treated 17 per cent were alive. At Trudeau Sanatorium a series of 106 cases with pulmonary and intestinal tuberculosis were treated. Eighty per cent of those treated lived. These figures are to me more than suggestive and justify the use of ultraviolet light until better methods of treatment are devised.

Maxwell<sup>9</sup> asserts that ultraviolet radiation is a promising method of treatment. Moore<sup>10</sup> believes that heliotherapy and ultraviolet have brightened the outlook for the patient with intestinal tuberculosis, similar to the results of surgery in pulmonary phthisis. His cases were irradiated three times a week and he feels that better results are attained by less tanning of the skin.

Walker<sup>11</sup> believes that heliotherapy is the outstanding development of the last decade in the treatment of intestinal tuberculosis. Frank<sup>12</sup> states that heliotherapy seems to be the most widely accepted form of special treatment and certainly has a marked effect in the relief of pain and other abdominal symptoms. However, in his opinion, not all cases bear this form of treatment well; their complaints are at times aggravated, especially if it is applied while the fever is high or when there are other signs of toxicity.

Bellinger<sup>13</sup> believes that ultraviolet has been the most fundamentally valuable form of treatment in his work with intestinal tuberculosis.

#### Complementary Therapy

The literature makes no mention of any specific drug therapy in the treatment of intestinal tuberculosis, but in general the high vitamin, high mineral



diet has been advocated; calcium therapy; intravenously, intramuscularly or by mouth, by some and heliotherapy—with or without emphasis on the diet—by others.

From the many authors that could be cited concerning the efficacy of calcium therapy one would be led to believe that the two general factors involved are (1) the pharmacologic action of calcium, and (2) the replacement of the calcium lost through the dehydrating action of the diseased intestinal tract, together with mineral loss through the sweat glands.

A deficiency of calcium in the circulatory fluids leads to increased excitability of the neuromuscular system, as is seen for example in tetany. According to the Council on Pharmacy and Chemistry the administration of calcium salts decreased the neuromuscular irritability in such cases.<sup>14</sup>

Although the diet as given by us is adequate in calcium for the normal person, it may prove deficient because of the extra losses of calcium from the tissues through the bowel and sweat glands. The good results obtained in this therapy may be due largely to the replacement of calcium in the tissues, together with its pharmacologic action. Direct exposure of the skin to ultraviolet light from the sun or from artificial sources forms vitamin D within the organism, but it should be borne in mind that the Council on Pharmacy and Chemistry<sup>14</sup> does not recognize statements or implications that vitamin D has all the beneficial effects of exposure to sunshine.

Since it has been shown by Tonney, Hoeft and Somers<sup>15</sup> that the ultraviolet content of sunshine in Chicago during the months between October and February is seldom sufficient to produce a minimum erythema dosage, it became necessary to resort to artificial radiation instead of natural sunlight in our series of cases. The dosage was the same as that adopted by Coulter and Carter<sup>16</sup> in the treatment of pulmonary tuberculosis by ultraviolet radiation. The ultraviolet radiation from both natural and artificial sources was administered by a modified Rollier method to secure a faint erythema over increasing areas of the body starting at the feet.

It is reasonable to assume that when pulmonary tuberculosis is complicated by intestinal tuberculosis that relative avitaminosis and demineralization are likely to exist. Therefore, the need of a high vitamin and high mineral diet for the relief of intestinal involvement becomes apparent. It was our object to study the practical application of the value of a high vitamin, high mineral, smooth diet calcium therapy and heliotherapy. For the comparative efficacy of each principle we divided our patients into eight groups. We arbitrarily limited our study to cases that were under treatment for six months or more. The groups are as follows:

Group 1-A were given the high vitamin, high mineral, smooth diet, plus ultraviolet.

Group 1-B were given the same as Group 1-A without the ultraviolet.

Group 2-A received calcium gluconate, grains 15, by mouth a half hour before meals, plus diet and ultraviolet.

Group 2-B received the same as Group 2-A without ultraviolet.

Group 3-A received 10 cc. of 10 per cent calcium chloride solution intravenously twice a week, plus the diet and the ultraviolet.

Group 3-B received the same as Group 3-A without the ultraviolet.

Group 4-A received 10 cc. of 5 per cent solution of calcium gluconate intramuscularly two or three times a week, plus the diet and ultraviolet.

Group 4-B received the same as Group 4-A without the ultraviolet.

The diet was smooth and of high vitamin, high caloric, high mineral content. In patients with excessive perspiration, or those giving a history of pro-

longed vomiting or diarrhea, we increased their mineral content by administering one-half to one teaspoonful of table salt in twenty-four hours.

The pulmonary condition of this group of patients roughly paralleled the intestinal condition. In other words the patients on the smooth, high caloric and high vitamin diet with or without calcium therapy plus ultraviolet radiation showed greater improvement than those with the same therapy without ultraviolet radiation. This was contrary to the findings of Coulter and Carter.<sup>16</sup> This apparently was due to the combination of diet and ultraviolet radiation, a report of which is being prepared for publication.

The criteria of gastro-intestinal improvement are based upon a comparison of the symptoms, physical findings and laboratory examinations, including x-ray, proctoscopic and complete blood studies before treatment is instituted with those found six months or more after treatment.

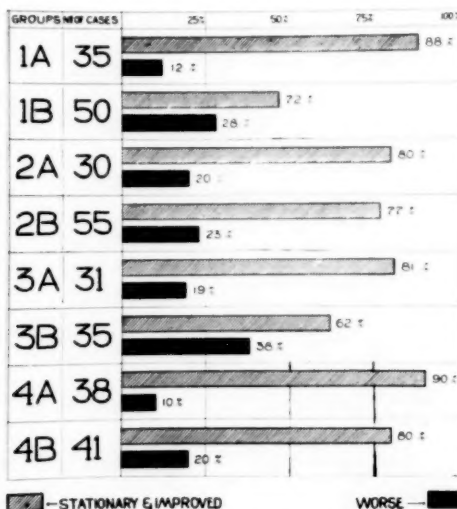


Fig. 1. — Ultraviolet radiation as a treatment factor as shown in a comparative study of the eight treatment groups. The A groups received ultraviolet radiation. The B groups did not receive ultraviolet radiation.

In brief, the general group of gastro-intestinal symptoms at the onset of treatment included loss of appetite, nausea, vomiting, abdominal pain, diarrhea or constipation, or diarrhea alternating with constipation, loss of weight or failure to gain weight. The criterion of improvement is a marked decrease in the frequency as well as in the duration of the symptoms, or their complete amelioration, together with a decided gain in weight, or at least a stationary weight. In a number of instances the gastro-intestinal improvement apparently exceeded that of the pulmonary condition. The favorable change in the abdominal findings is characterized by a diminution or absence of rigidity and a lessening or disappearance of local tenderness. Slight to moderate localized abdominal physical findings may persist even after a marked weight gain and complete disappearance of symptoms. X-ray evidence of lessened bowel irritability usually accompanies symptomatic improvement and diminution of physical signs. This has been demonstrated in a number of instances by x-ray examination of the gastro-intestinal tract six months or more after medical treatment has been instituted. The blood picture failed to show any definite changes characteristic of improvement. In fact, in every group there was a slight tendency for the red blood count to decrease during the six months or more of treatment.

The cases studied for this report represent a total of three hundred and

fifteen. In reviewing the chart, we find that those patients who did not receive ultraviolet radiation, groups 1-B, 2-B and 3-B and 4-B showed a lower percentage of improvement than the same groups receiving ultraviolet radiation. This radiation apparently decreases the symptoms, or at least keeps them stationary in the larger percentage of the cases in all the groups, with or without calcium therapy.

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### Discussion

**Dr. Morris Weisman** (Chicago): This report has important implications because it is based on a large number of cases and covers observations of a period of five years. I say this because one report dealt with only 80 cases and the period was rather brief. The conclusions then were quite different. Another feature about this work is that the authors had eight groups and the groups could be used as controls one against the other. It is gratifying to see that there is a definite tendency toward greater improvement in those receiving ultraviolet as compared with those who did not. Another feature about the report is that the authors do not claim ultraviolet to be a panacea. They regard it merely as an adjunct, and since they do that the likelihood for them to go too far afield is not great.

**Dr. A. L. Banyai** (Wauwatosa, Wis.): The great majority of patients admitted to institutions arrive there in advanced stages of the disease. The Manitoba Sanatorium in 1937, admitted as many as 93 per cent of the cases in the moderately and in the far advanced stages of the disease. This means that the chances for recovery in this group of patients is rather poor.

Nothing shows the truth of this statement better than the postmortem reports. Engleman reported that patients who die from tuberculosis have evidence of the ulcerative type of intestinal tuberculosis in as high as 92½ per cent of the cases. Now we must realize that practically all of our far advanced cases pass through a stage when they sooner or later develop intestinal tuberculosis. Are we diagnosing tuberculosis in 92½ per cent of our cases? We are not, because we still do not have the diagnostic consciousness, do not interpret the symptoms properly, do not carry out a thorough clinical investigation, and finally because of the unfortunate fact that many cases of intestinal tuberculosis present no symptoms.

Steinbach reported that on postmortem examination he found 62 per cent of the patients who had evidence of the ulcerative type of intestinal tuberculosis did not have a single clinical symptom during their lives. Therefore, I think it is timely to reemphasize the statement of the late Dr. Stewart, of the Milwaukee County Sanatorium, that one should not wait until symptoms of intestinal tuberculosis develop, that one should rather anticipate intestinal tuberculosis, or as the late Dr.

Schmidt has said, no one should consider the diagnosis of a moderately or far advanced tuberculosis complete until one has made a study of the gastrointestinal tract for proving or disproving the presence of tuberculosis.

Now as far as treatment is concerned, I agree with Dr. Coulter and Dr. Hardt on practically every point. I may say that I have been using the Sauerbruch-Hermannsdorfer-Gerson diet, the so-called salt-free diet in my sanatorium practice since 1929. This eliminates sodium chloride from the diet on the basis that ordinary food intake in twenty-four hours, containing four grams of sodium chloride, is sufficient to cover the minimum requirements of the body. The rest of the sodium chloride we take is supposed to be a condiment. By eliminating the sodium chloride from the diet and by giving large doses of calcium lactate one is able to substitute the sodium ions in the tissues by calcium ions.

I feel that the crux of the whole situation is how to treat intestinal tuberculosis cases when the pulmonary process is in the advanced and the exudative stage. I have been using artificial and natural heliotherapy for a great many years. I know that it has many limitations and the only proper way to carry it out successfully in pulmonary cases is to keep a close check on the clinical symptoms as well as on the evidences gained by sedimentation tests, monocyte and lymphocyte determinations, and the Schilling blood count. I may say that the responsibility of carrying out heliotherapy correctly in an exudative case of pulmonary tuberculosis is as great as performing a major operation successfully.

Can we give heliotherapy to patients who have an exudative, far advanced pulmonary tuberculosis without great risk? I am afraid not, or only in a very limited number of cases. This unfortunately is not only my personal experience but also that of outstanding men. It was the experience of the late Dr. Brown and of Dr. Sampson. We were at a difficult point in this situation and the only way out was to resort to another measure related to physical therapy, namely, artificial pneumoperitoneum. Since 1929 I have been using this measure. It was first reported by Jelks in 1922. I have never seen a focal reaction and destruction of pulmonary tissue follow pneumoperitoneum, as I have seen many times after heliotherapy. Not only that, but we have x-ray evidence that pneumoperitoneum is capable of reducing intestinal peristalsis. Therefore, I feel that in cases where our possibilities with heliotherapy are limited we should not forget to resort to artificial pneumoperitoneum.

Before I close my discussion I should like to ask Dr. Coulter one or two questions. First, what importance does he attribute to the shift of the pH of the tissues as the result of irradiation to the alkaline side, in view of the fact that reduction of

acidity of the stomach may cause an upward spread of the ulcerous process? What importance does he attribute to the fact that while minimal irradiation will increase the vitamin D production of the skin, intensive irradiation will destroy the vitamin D?

Finally, I should like to know what importance does Dr. Coulter attribute to the possibility of producing in the skin what was described by Rickert and Turk in combination with arterial hemotherapy in the treatment of syphilis. I wonder whether or not Dr. Coulter could give us a suggestion as to the possibility of using the same measure in the treatment of intestinal tuberculosis.

**Dr. John S. Coulter** (closing): Dr. Banyai has asked two questions and I confess that I cannot answer them. If he means vitamin D reduction in the skin, as far as I know it depends upon the wavelength of the radiation. You know that the short wavelengths, such as produced by the cold quartz lamp, will often destroy vitamin D production in the skin. I do not believe that intense irradiation will destroy it if it is of the proper wavelength.

**Dr. Leo L. Hardt** (closing): With reference to the alkaline tide in tuberculosis, in the experiments that I did a few years ago on twenty normal subjects during a series of intermittent sweat periods, I believe I demonstrated fairly conclusively that there was a considerable chloride loss as well as calcium loss through the skin, and that most probably these subjects suffered from a tissue alkalosis. I had in mind the tuberculous patient when I did these experiments.

In the gastro-intestinal work at the sanatorium the thought occurred to me that the tuberculous patient particularly the one with gastro-intestinal tuberculosis was probably suffering from an alkalinity similar to those normal subjects when subjected to intermittent heat sweats, that there was a definite increase in salt and calcium loss, and for that reason we have emphasized a high mineral diet, reinforced by sodium chloride and calcium.

We have had too many instances of nausea and vomiting in these patients with gastro-intestinal tuberculosis who have responded to a high salt diet to be more than just coincident. Unfortunately as yet we have not had courage enough to attempt the same type of experiments on the tuberculous patients that we tried on the normal subjects; in other words, putting them through four intermittent heat and sweat periods of fifteen to twenty minutes each, and collecting the sweat and analyzing that together with the other body secretions. I was surprised to hear one of the discussers mention the fact that they have their patients on a low salt diet. It seems to be that this is quite contrary to our findings in the normal subjects as well as to our results in the treatment of intestinal tuberculosis.

## WASSERMANN-FAST SYPHILIS WITH SPECIAL REFERENCE TO PYRETOTHERAPY \*

JAMES K. HOWLES, M.D.

NEW ORLEANS

Of all the problems confronting the clinician today none presents so great an enigma as the Wassermann-fast case. The frequency with which one encounters the non-reversible Wassermann type of case or the so-called Wassermann-fast syphilitic infection seems to be increasing. Investigators are no longer accepting this condition as a syphilologic tradition, but are seeking to learn why under identical methods of treatment controlled all cases of a similar syphilitic status do not respond the same way to the prescribed therapy. Certainly Ehrlich would have understood why arsphenamine was not the panacea he had thought it to be, had he been familiar with the clinical vicissitudes of the disease we know as syphilis, and the varied responses of the human economy to that infection and its therapeutic endeavors.

What comprises a Wassermann-fast case and which factors enter into its development is a much mooted question among syphilologists. Our conception of Wassermann irreducibility includes those cases which persistently show a positive blood reaction despite the administration of acceptable forms of specific therapy in a series of courses involving periods ranging from many months to several years.

As clinical studies progress we find that the occurrence of syphilitic complications associated with Wassermann-fastness are far more numerous than were previously suspected. Stokes and Busman<sup>1</sup> early saw the necessity for study of these undesired complications, and the need for their clinical classification. Wassermann-fastness must be differentiated from those cases which have developed a relative degree of tolerance to the arseno benzenes or heavy metals.

That the persistently positive blood Wassermann reaction indicates syphilitic infection in the patient is shown by the clinical study of many syphilologists. The above referred contribution of Stokes and Busman<sup>1</sup> is especially valuable in emphasizing the point that a positive blood Wassermann even in asymptomatic cases discloses the probability of hidden syphilitic lesions.

Search for these obscure foci and a determination of the value of some of our more acceptable methods of obliterating them without undue harm to the system is the purpose of this paper. A clinical classification of the syphilitic complications encountered in these series was (table 1).

The high percentage of cardiovascular and central nervous system cases is quite appalling. The lack of osseous lesions in this series was surprising since Stokes included 30 per cent of osseous syphilitic complications. The reason for the absence of this syphilitic manifestation is probably because so many central nervous system cases were included in our group. No selection of cases was made in this series other than Wassermann-fastness.

### Routine Examinations

That the method of their examination included multiple diagnostic procedures as the necessity for thorough clinical search to detect many of these hidden foci is obvious. They are:

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\* Read at the Sixteenth Annual Session of the American Congress of Physical Therapy, Cincinnati, Ohio.



TABLE 1. — *Types of Syphilitic Manifestations.*

<i>Syphilitic Status</i>		
	Cases	% of 112 Cases
<i>Cardiovascular Syphilis</i>		
Aortitis .....	18	16.6%
Myocarditis .....	15	13.4%
Aneurysm .....	2	1.8%
Aortic Regurgitation .....	2	1.8%
Aortitis — Myocarditis.....	4	3.6%
<i>C. N. S. Syphilis</i>		
Paresis .....	16	14.3%
Tabes Dorsalis .....	11	9.8%
Taboparesis .....	19	16.9%
Meningovascular Syphilis .....	1	.09%
<i>Congenital Syphilis</i> .....	6	5.4%
<i>Asymptomatic Syphilis</i> .....	28	25.0%
<i>Tertiary Syphilitic Manifestations</i>		
Visceral .....	5	4.4%
Cutaneous .....	4	3.6%

1. Wassermann reaction (Kolmer modification).
2. Spinal fluid surveys including cell count globulin test; gum mastic or colloidal gold test, and quantitative Wassermann reaction.
3. X-ray examination of chest with measurements of heart and great vessels.
4. Electrocardiogram in all cases presenting symptoms of cardiac disease.
5. Complete blood study including red and white blood cell counts, differential count, hemoglobin and blood chemistry.
6. Urinalysis.
7. Complete physical check up including examinations by an ophthalmologist, cardiologist, orthopedist, oto-laryngologist, neurologist, internist and dentist.
8. X-ray of long bones in all congenital cases and those showing symptomatology suggestive of osseous syphilis.

As so many statistics are included in this series no attempt will be made to present the viewpoints of various syphilologists on the subject matter here presented, but shall confine most of our remarks to the therapeutic evaluation of the study. Several points are especially conspicuous in the foregoing clinical studies:—

1. The high incidence of syphilitic complications in Wassermann-resistant cases, particularly those of the cardiovascular and central nervous system.
2. The need for thorough "ferretting" out hidden foci even in asymptomatic cases.
3. The multiple visceral complications that co-exists in the same patient thus refuting the possibility of neurotrophic and dermatotropic strains.

### Therapeutic Survey

The cases were grouped into three series. The cases of group 1 showed a persistently positive blood Wassermann with no changes in the spinal fluid. Cases in this group were given various forms of chemotherapy as well as electropyrexa. The latter of this group embraced twenty-two cases (table 2).

The second group included only Wassermann fast cases showing evidence of central nervous system syphilis both clinically and serologically. To this group of 37 cases electropyrexa was given as well as certain chemotherapeutic agents (table 3).

In the third group of this series were placed patients, some of whom showed clinical and serological evidence of central nervous system syphilis. All mani-

TABLE 2.—*Electropyrexia in Wassermann-Fast Cases With No Spinal Fluid Changes.*

	Cases	% of 22 Cases
Colored .....	12	54.5%
White .....	10	45.4%
Males .....	16	72.7%
Females .....	6	27.2%
<i>Syphilitic Status</i>		
Cardiac Complications .....	10	45.4%
Aortitis .....	5	22.7%
Myocarditis .....	6	27.2%
Average number of electropyrexia treatments per patient—14.		
Number of cases in which Blood Wassermann reverted to negative—3 or 13.6%.		

fested persistently positive blood Wassermann tests. No electropyrexia was used in this series, but certain forms of chemotherapy were administered.

It is obvious that all of the therapeutic agents used in the treatment of Wassermann-fast syphilis could not be included in any one survey to a degree that would justify comparison. Hence a few of the more acceptable methods were used to compare the results obtained with and without supplementation of electropyrexia. Schamberg and Wright<sup>2</sup> expressed the hope that the use of non-specific or "fever" therapy would aid in solving the enigma of the reducible Wassermann reaction. As stated before nothing was attempted in the way of proof, our study being limited to an unselected group of cases of syphilis in which the Wassermann was persistently positive despite many months, and in some cases years of specific therapy as intensive as the individual case would tolerate.

In an effort to learn what to do with the patient showing a persistently positive blood Wassermann in the way of modification of therapy I have tried rest periods with an effort to build up the so-called resistance of the patient, as suggested by Tobias.<sup>3</sup> This method was tried in far advanced cases but with results that were not encouraging. The cases used were too advanced for a fair type

TABLE 3.—*Electropyrexia in Central Nervous System Syphilitic Cases With Persistently Positive Blood Wassermann Reaction.*

	Cases	% of 37 Cases
Colored .....	20	54.15%
White .....	17	45.8 %
Males .....	25	67.5 %
Females .....	12	32.4 %
<i>Syphilitic Status</i>		
<i>C. N. S. Cases</i>		
Paresis .....	12	32.4 %
Tabes Dorsalis .....	10	27.0 %
Taboparesis .....	14	37.8 %
Meningovascular Syphilis .....	1	2.7 %
<i>Cardiac Complications</i> .....	9	24.3 %
Cardiac { Aortitis .....	3	8.1 %
Myocarditis .....	4	10.8 %
Aortic Regurgitation .....	1	2.7 %
<i>Other Complications</i>		
Malaria .....	1	2.7 %
Epilepsy .....	1	2.7 %
Optic Atrophy .....	2	5.4 %
Average number of electropyrexia treatments per patient—14.		
Number of cases showing a reversal of Blood Wassermann to negative—9 or 24.3%.		

on which to base an evaluation of this therapeutic adjunct. At the present time we are treating a series of Wassermann-fast cases with intravenous sodium thiosulphate as advocated by Beinhauer and Jacobs.<sup>8</sup> It is too early to include the results in this report, but the method gives promise of confirming our work as effective.

The value of certain of the arsenobenzenes, such as arsphenamine (606) and sulpharasphenamine, is admitted, but these drugs were not used in this series because space would not permit inclusion of such a large variety of drugs. Only a very few therapeutic agents are included in this series and time will permit only their very meager discussion.

Therapeutic agents used in this series were:

A. Chemotherapeutic

1. Arsenicals

Neo-arsphenamine

Tryparsemide

2. Heavy metals

Bismuth subsalicylate

Mercury inunctions

3. Combined drugs

Bismuth arsphenamine sulphonate (bismarsen)

5. Iodides

Sodium iodide

Potassium iodide

B. Physical Measures

1. Electropvrexia

Neo-arsphenamine was used in this series in all cases where intravenous administration of arsenicals was not contraindicated. While the therapeutic superiority of arsphenamine over neo-arsphenamine is admitted by most syphilologists the wider acceptance of neo-arsphenamine caused by its high therapeutic index and ease of administration prompted us to use it in this series as our basic arsenical. Certain other forms of arsenic, such as the pentoxide in the form of tryparsemide or combinations of arsenic and heavy metal, such as bismuth, arsphenamine sulphurate (bismarsen) were also employed. Neo-arsphenamine was given in doses ranging from .3 Gm. to .6 Gm. at weekly intervals.

*Bismuth* — In estimating the anti-syphilitic powers of a drug, a study of the clinical response, as well as the effect on the blood Wassermann reaction must be considered. As cited by Schamberg and Wright<sup>2</sup> the popularity of bismuth today is due, in no small part, to the excellent work of Sazarac and Levaditi,<sup>4</sup> whose conclusions concerning the use of bismuth in syphilis need no reiteration at this time.

Moore<sup>5</sup> has stated the frequency of Wassermann-fastness in any stage of syphilitic infection to be directly dependent on the sensitivity of the serologic test. Much progress has been made in Wassermann technic since Levaditi and his co-workers have made their studies, all of which magnify the value of bismuth as a heavy metal "par-excellence."

Since relatively few contraindications exist to intramuscular bismuth injections, all of our cases received this drug alone or in combination with some other specific agent. In our series we used the insoluble bismuth subsalicylate. It was given in one cubic centimeter doses containing approximately 136 mgm. of bismuth and butyn as a local anesthetic. It was given at weekly intervals in conjunction with some other form of therapy.

*Tryparsemide* — This pentavalent arsenical compound was used only in central nervous system syphilis with persistently positive blood Wassermann tests. A careful examination of the eyes, including visual field examination was done

on all patients prior to instituting treatment with tryparamide. The visual fields were checked at frequent intervals irrespective of any subjective symptomatology relative to the eyes. Whether the ocular disturbances frequently encountered following tryparsemidate therapy are due to a specific affinity of the drug for the optic nerve producing changes of a toxic nature, or to the disease process being stimulated by the tryparsemidate is not known, but the frequency which these occur warrants caution in the use of the drug. Any patient complaining of blurring of vision was taken off tryparsemidate until a recheck of the eyes and determination of visual acuity and perimetric fields was repeated and compared with previous records. If the tests showed decrease in visual acuity then another method was substituted for the pentavalent arsenical.

Our experience with tryparamide leads us to believe that the drug has little spirocheticidal power. The reversibility of the blood Wassermann tests when this drug was used alone without supplementing heavy metal therapy has been negligible. The clinical response was much more encouraging and much more rapid than the serological responses. The general physical improvement was in some cases most striking.

Tryparamide was given in doses of 1 Gm. to 3 Gm. intravenously, once to twice weekly in conjunction with intramuscular bismuth subsalicylate and in some cases electropyraxia also was included.

*Bismuth arsphenamine sulphate* (bismarsen) is a synthetic arsphenamine preparation containing approximately 12 to 15 per cent arsenic and has a bismuth content of 23 to 25 per cent. It was given in doses of .1 Gm. to .2 Gm. in one cubic centimeter of a diluent containing sterile water and .25 per cent butyn. The drug was used in conjunction with potassium iodide and electropyraxia. When used alone it was given twice weekly, but when used with some other form of specific therapy it was given only at weekly intervals. Our findings in the use of this drug are to a great degree in accord with Tobias<sup>6</sup> who was most enthusiastic in his praise of bismarsen. We share his opinion of the good effect of the drug in its tonic and weight increasing properties, beneficial action in the tabetic pains and the relative simplicity of the technic, but regarding its power to reverse the blood Wassermann we are not quite convinced.

As a drug useful in converting a blood Wassermann it seems to have some value, but this series does not prove it to be superior to other chemotherapeutic agents. It is a most desirable addition to our arsenical group in cases which cannot tolerate intravenous neo-arsphenamine. Certain cardiac cases which seem to be unable to stand even small doses of neo-arsphenamine intravenously seem to accommodate the intramuscular injections of bismarsen quite well. The pain following the injections is diminished by using a diluent containing butyn. By further diluting the mixture with one-half cubic centimeter of one per cent procaine hydrochloride even the most vigorous objector seemed to tolerate the drug.

The results obtained by Hadden and Wilson<sup>7</sup> in the treatment of tabes dorsalis with bismarsen were confirmed in our clinical experience. It seems to be definitely superior to tryparamide in the early cases of tabes dorsalis, although the results in late cases were not as consistently good.

### Electropyraxia

So much has been written concerning the use of febrile body temperature in late syphilis that a survey was recently conducted by me to compare two accepted forms of pyretotherapy, namely, induced malaria and electropyraxia in the later group. The results were so encouraging in central nervous system syphilis that a comparison of this fever therapy with several generally used forms of chemotherapy seemed indicated in Wassermann-fast cases.

The electropyraxia technic employed was as follows: the patient is first

subjected to a complete physical, neurologic and laboratory examination. He is given an enema the night before treatment. Breakfast is limited to fluids. One gram of sodium iodide is given intravenously the night preceding the treatment. Three grains of sodium amytal or some similar sedative is given immediately before the treatment. All patients are weighed before each treatment is started. The patient is placed on the fever bed and a terry cloth or large bath towel is wrapped around him. He is then placed in an insulated zipper bag, the head only remaining exposed. The mattress on the fever bed is in two parts to permit the introduction of the induction coil between them. The coil is wrapped three times around the body of the patient. The apparatus is turned on full force until the temperature of the patient registers 104.5 F. The current is shut off to permit the usual coasting upward of one-half degree of temperature. Temperature, pulse and respiration are taken and recorded every fifteen minutes.

Some patients will retain a temperature of 105 F. for several hours after interruption of the current; others will require earlier reestablishment of connection with heat. The temperature of 105 F. is usually reached in 60 or 90 minutes and maintained for five hours. Most patients become restless after about four hours of the elevated temperature and require another sedative. During the treatment 1500 to 2500 cc. of 0.6 per cent saline and water are given the patient. Early in the treatment fluids are given sparingly but when the temperature reaches 105 F. liquids are given freely.

The patient is moved from the fever bed, placed on a dry bed and covered with blankets. At this stage fluids are forced. The temperature rapidly descends from 105 to 103 F. from which point it proceeds more slowly to normal. The usual time required for the temperature to reach 100 is forty-five minutes to an hour. After the treatment is completed the patient is bathed and returned to his ward where an infusion of 10 per cent glucose in normal saline is administered.

The technic employed when the patient is treated in the Kimble cabinet is similar to the bag treatment just described. There is a greater loss of weight in patients treated in the bag than in those treated in the cabinet. The average weight loss in the former is six pounds, while the average loss during the cabinet treatment is only one and a half pounds. The intervals between the treatment is usually one week, but in a few cases, especially those who suffer considerable loss of weight, the treatments are given bi-monthly. The greatest loss in weight recorded in our series during one treatment was fifteen pounds.

### Comment

The serologic results obtained in the various groups are not striking, but there was a definitely larger percentage of reversal of blood Wassermann reactions in those groups in which electropyrrexia was used as a supplementary therapeutic measure. The clinical responses greatly surpassed the serologic results. The number of reversals of blood Wassermann in the groups were:

1. Central nervous system cases with persistently positive blood Wassermann in which electropyrrexia was used showed in 37 cases 9 or 24.3 per cent with reversal (table 3).
2. Wassermann-fast cases with no spinal fluid changes in which electropyrrexia was used gave 3 or 13.6 per cent out of 22 patients (table 2).
3. Wassermann-fast cases some showing spinal fluid changes in this group, without electropyrrexia being given revealed 3, or 5.7 per cent reversals out of 53 patients.

Since the same form of chemotherapy was used in all groups the supplementing electropyrrexia to some of the cases made it possible to use these as controls.



All the patients were given mercury inunctions and potassium iodide drops while on their so-called rest intervals which were prescribed routinely. This procedure followed to some extent the plan outlined by the cooperative clinic groups, but in the series both intramuscular bismuth subsalicylate and some form of intravenous arsenical were used during the same period, at least for part of the time unless definite contraindications existed to either type of treatment.

### Conclusions

1. Electropyrrexia seems to be of definite value in the treatment of Wassermann fast syphilis.
2. When used as a supplement to chemotherapy it has greater value.
3. The tolerance to the heavy metals seems to be enhanced by use of electropyrrexia (clinical observation).
4. Even certain cardiac cases tolerate the fever treatments in conjunction with conservative chemotherapeutic measures.
5. A definite search for associated visceral lesions or other syphilitic foci is essential in all cases of Wassermann-fast syphilis.
6. The change of drugs seems less desirable in these cases than is a thorough search for the factors which produce this state of fixation.
7. Perseverance seems to be the keynote both in examination and treatment of the Wassermann-fast syphilitic case.

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### Discussion

**Dr. Elmer Hess** (Erie, Pa.): I believe that I owe a portion of my present success to the fact that from the beginning of my medical career I have recognized syphilis as the great actor and imitator. I have always considered every patient as a potential syphilitic and have made routine Wassermann tests on every one who has consulted me for more years than I like to tell. Wherever there has been the slightest suspicion of the presence of the disease I unhesitatingly check a negative Wassermann with a spinal tap. Therefore, after twenty-six years of this type of practice I may be partially qualified, at least, to discuss this subject.

Let us for a moment review a few facts. First, the Wassermann test per se, is not a test for syphilis: it is a test for lipoids in the circulation. A few may be named: scarlet fever, meningitis, yaws, and other spirochetal diseases other than that caused by the spirochaeta pallidum. It may be said, however, that in the temperate zone the one disease that causes lipoids to freely circulate in the blood stream is our constant companion, the spirochaeta pallidum, and as most of us practice in this zone we may be perfectly safe, in the vast majority of cases where we find positive Wassermans, to diagnose syphilis. However, in the presence of the positive Wassermann alone, we may

have to be very careful in making such a diagnosis. We must not depend solely upon the laboratory. History, symptoms, other findings, and treatment often must help us to render a correct diagnosis. To condemn a patient as syphilitic on a positive Wassermann alone is reprehensible and this has been done much too often; equally bad is the practice of ruling out syphilis merely on a negative Wassermann test. Again, we do not know why some patients with syphilis who have had adequate treatment still have positive reactions. What is the biologic, chemical change that has taken place in their bodies that prevents the circulating lipoids from disappearing from the blood stream? Is this necessarily due to active syphilis or has the patient something else that we have failed to find? I am sure I am not able to answer the question. I am, however, satisfied that when a patient known to have syphilis has received adequate treatment over a long period of time, and he is symptom-free and also free from all progressive signs of his original disease, living a normal life, submitting to frequent physical check-ups by competent men, I wouldn't be bothered very much whether he had a positive Wassermann or not.

I was extremely interested to have Dr. Howles point out the fact that many of these patients who are Wassermann-fast do have active lesions somewhere. He has said and rightly so that in many of these cases we are unable to locate the active area. Search should be made and every possible examination carried out that will possibly disclose the source of the active lesion. He has mentioned the cardio-vascular types, those of the central nervous system, the congenital, the asymptomatic and the so-called tertiary manifestations. These cover practically the entire body. I would call your attention to the kidney as a possible active focus. True, the kidney lesions may be classified under the general one which Dr. Howles designates as a visceral complication. However, the kidney can be and often is the site of the active visceral lesion. As a urologist I have seen many Wassermann-fast cases of nephritis clear under proper therapy and where many men fear to use the heavy metals in these individuals I have seen them exhibited with very gratifying results. However, I will not criticize the syphilographer who disagrees with me on this subject, but will close this discussion with a few very important suggestions to all who attempt the management and treatment of syphilis, whether Wassermann-fast or not.

1. Do not treat the disease—treat the patient. Each is a law unto himself.

2. Do not force the arsenicals too vigorously in those patients who have visceral syphilitic lesions.

3. Do not forget that mercury by mouth in the form of the protiodide is still good

treatment, regardless of whether a patient with old syphilis has a positive or negative Wassermann.

4. Regardless of the Wassermann reaction the patient should be under observation of a competent medical advisor for the rest of his natural life and no treatment that makes the patient lose his appetite or disturbs his physical well being is good treatment.

**Dr. Walter Zeiter (Cleveland):** After hearing this paper one cannot help but realize the great amount of work Dr. Howles has done. The Wassermann-fast patients are receiving more and more attention to establish a better method for treatment. Prior to the time of the opening of our artificial fever department most of these patients were treated with malaria at the Cleveland Clinic. We now have a number of patients who have had artificial fever. However, the number and time since treatment was given is too short, to make any comparative study. One advantage may be mentioned, that in many instances some of these patients can be treated by electropyrrexia in which malaria would be far too dangerous.

I would like to ask one question, and that is, when were injections given to these patients during the administration of hyperpyrexia? We have used primarily the same method as Dr. Howles describes to elevate the body temperature, but we have certain modifications that we feel are advantageous.

To overcome the oppressive weight of the bag, the aluminum metal cabinet is used. Due to the good insulation and humidity not much heat is lost from the patient after the temperature is once elevated and therefore it is not necessary to apply heat again by electromagnetic induction. Also in this cabinet the cable is placed under the patient in a single loop which covers a greater area, thus giving a more uniform heating.

We also feel that giving the patient breakfast on the day of the treatment—that is 1½ to 2 hours before being put into the cabinet—helps to prevent exhaustion and thus aids the patient to better tolerate treatment and avoid intravenous medication.

**Dr. L. Stadiem (New Orleans, La.):** In closing I wish to say that the treatments were given conjointly, for instance, one would be given the injection at the beginning of the week and the treatments at the end of the week.

Before leaving I tried to pin Dr. Howles down to one idea on this problem, and he said that although Wassermann-fastness was reversed in a few cases, he did not think that electropyrrexia was—I am trying to find the word—not all important, not all sufficient. He did not think it was really so important that it should be given in conjunction with the treatments to reverse the Wassermann-fastness. I hope I have not confused you with that statement.

## RE-ESTABLISHMENT OF THE CIRCULATION IN EXTREMITIES \*

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The re-establishment of circulation in diseased extremities has received considerable attention. Many forms of therapy, both physical and chemical, have been devised to increase the blood supply in the tissues. The great array of methods for the treatment of this condition found in the literature speaks for the inefficiency of them all.

The major consideration before any treatment is instituted in any disease should be the establishment of the proper diagnosis. Many different factors and diseases enter into a symptom complex that is usually recognized as occurring with peripheral vascular disease so as often to render difficult the recognition of the basic condition. Such varying factors as local or general tissue resistance, disease of the nerves, or local or general reduction of the blood supply together, or independently, may contribute to such a complex of symptoms, not to mention factors of posture, muscle tension and the like, which may cause the patient to seek medical aid. Our subject, however, is limited to re-establishing the circulation in an extremity and is not devoted to the treatment of peripheral vascular diseases as such.

Since many methods have been devised for the re-establishment of the circulation in peripheral vascular disease, and as most of them are essentially without great importance, I shall restrict my discussion to some experimental work that was done in our laboratory at the Washington University in the past three years with Dr. John R. Smith. I shall attempt to demonstrate the principles which have been established and believed to be essential in re-establishing the circulation in peripheral vascular disease.

With the advent of the passive vascular exercise machine developed by Herrmann and Reid, interest was revived in the treatment of vascular disease. The apparatus was hailed with considerable enthusiasm by the original observers. Later reports in the literature, however, have been less enthusiastic. Especially notable in this regard is the work of Wilson and Roome, Allen and Brown. Since 1935 we have had an opportunity to study the influence of this machine on individuals with diseased extremities. Beneficial effects were noted in some cases, especially in relieving the pain of asthenic neuritis. As only fair results were noted on a very few individuals the effect of the treatment could not be classified as good. Some were relieved of the pain while their legs were in the appliance or during the first few weeks after treatment began; but over a period of six months, little, if any definite improvement in ambulatory patients either in the pain associated with vascular disease or increased blood supply could be noted. A few of the patients especially those with thrombo-angiitis could not tolerate the treatment.

### Laboratory Studies

Because of the limited benefits and the large number of poor results obtained by passive vascular exercise and also other forms of therapy, we decided to study the problem in the physiologic laboratory. Since analysis

\* From the Barnes Hospital and Washington University Department of Internal Medicine, St. Louis, Missouri.

\* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 13, 1938.

of the problem could not readily be made on the extremities of animals or living man, other methods of study had to be devised. Thus the extremities of individuals who had recently died were reperfused and studied. The following was the usual technic employed. Just preceding death one of the extremities was raised so as to empty the venous blood from its veins. The other was lowered over the side of the bed or was subjected to a pressure of 20 mm. Hg. by means of a blood pressure cuff in order to maintain a full venous system. By this manipulation it was possible to study the influence of venous pressure on the arterial flow in the recently dead extremity. Studies were made on the influence of diseased capillaries and arteries, the venous pressure, the cardiac output on the blood flow into the legs. We also observed on such a set-up the influence of heat, iontophoresis and other forms of physical and chemical therapy on the inflow of blood. Since the nervous system was dead any nervous reaction could not be studied (fig. 1).

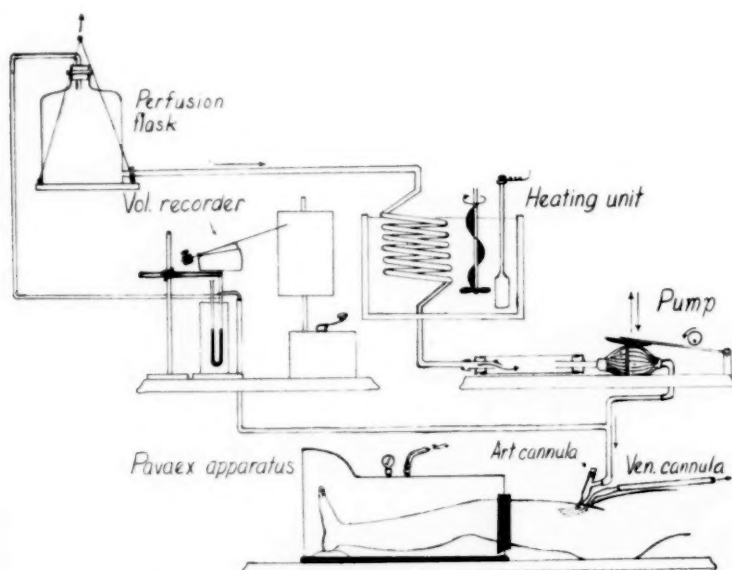


Fig. 1. — Diagram of the perfusion apparatus used.

Immediately post mortem, cannulae were placed in the femoral arteries, and in the femoral veins, the arterial cannula was then connected to an artificial pump or to a heart-lung preparation. Especially prepared animal blood was then perfused through the extremity. The inflow of blood to the artery was measured by means of a flow meter in the case of the heart-lung preparation, or a volume recorder in case of the artificial heart. In each instance a pulsatile pressure was used in order to stimulate that produced by the normal beating heart.

Observations were made on extremities of individuals whose blood vessels were normal and on those which were diseased. In normal legs, whose veins had been emptied ante mortem, difficulty was encountered in forcing the blood into the arteries, even when the procedure was attempted immediately after death. In such cases it was necessary to place a tourniquet around the leg and to elevate the venous pressure from at least 10 to 20 mm. Hg. to re-establish a maximum arterial inflow. In normal legs whose veins were distended before death, no difficulty was encountered in passing blood through the extremity from the artery to the veins, unless sufficient time had elapsed to permit the blood to clot. The amount of blood flowing

\* For the use of cuts, figures 1 and 2 acknowledgment is accorded the author, the American Heart Journal and the C. V. Mosby Company.



into a normal extremity did not vary greatly from that established by other methods in man. The extremities of individuals with clinical disease of the peripheral arteries were more difficult to study. In the first place, it was not possible to obtain a calculated arterial inflow and one was always less certain that one was getting the same amount of blood flowing into the legs that had occurred before death. Under these circumstances the greatest possible inflow obtained during the experiment had to be taken as the probable flow before death. The maximum inflow varied with each extremity, and, of course, had to be established independently for each diseased leg.

A second type of obstruction was encountered in diseased extremities that was not present in the normal ones. Difficulty to the passage of blood in the former was experienced until it was discovered that hypertonic saline (3 per cent or higher) perfused through the vessels relieved an obstruction. This phenomenon could be seen in the vessels of normal legs only after they had been permitted to stand 30 or 40 minutes. Clotting of the blood in the vessels was ruled out as a cause of obstruction by carefully washing with heparinized Ringer's solution immediately after death and then allowing the legs to stand. In the diseased blood vessels or in normal ones sometime after death one could not obtain, or even approach a maximum flow through the extremity unless a dehydrating agent was passed through the capillaries. It was necessary to pass at least 200 cc. of hypertonic saline solution from the arterial to the venous side. Since the only similarity between the normal legs standing and the diseased legs was that the extremities had been deprived of oxygen, it was considered possible that the phenomenon was due to a reaction of degeneration of the capillary cells in which swelling and occlusion of the capillary lumen occurred. It was assumed that the action of hypertonic saline in opening diseased vessels was due to dehydration of the capillary endothelium. This seemed logical in view of the fact that Krogh had described such a phenomenon of capillary closure in the state of anoxemia. More recently the work of Smith and Kountz has demonstrated another possibility, which is that certain sodium salts especially sodium chloride have a primary action of dilatation when perfused through the vascular tree. Increasing the arterial or venous pressure appeared not to influence the arterial rate of flow under these conditions.

The difference in blood flow in legs whose venous system was full and those empty indicate that venous pressure has an important influence on the passage of blood from the artery to the veins of an extremity. This has been demonstrated by previous observers in the treatment of peripheral vascular disease; namely, Silbert, Lillendhal, Collens, and Wilensky. A collapsed venous system appears to obstruct the passage of blood from the artery to the veins and even though one may under experimental conditions increase the arterial pressure many times, it is impossible to force out only small amounts of blood through the vascular tree when the venous side is closed. In other words, the venous pressure appears to act as a valve which can only be opened by back pressure from the veins. Increasing the pressure within certain levels tends to increase the arterial flow.

### Experiments With Apparatus

In other experiments on the same extremities, after the maximum blood flow had been established, the pavex apparatus was placed over the leg. Usually the arterial inflow as well as the venous output was diminished during the negative phase of the cycle. In three experiments the instrument caused a definite decrease in the total blood flow during the time of the boot was on the extremity. There was some variation of inflow to both the nor-

mal and diseased extremities. Immediately after the negative cycle began, there was a slight increase in the arterial inflow; whereas immediately after the positive pressure was applied, the outflow from the venous side was increased. Change in the negative pressure did not increase the inflow into the legs with the artificial circulation. The best results with this machine seemed to be obtained with no, or only a slight degree of negative pressure and a positive pressure of about 20 to 40 mm. Hg. An apparatus of the so-called pavex type was found in our experiments to be inferior in producing an increase in blood flow through the extremities to one which contained a series of blood pressure cuffs which tended to milk the blood into the leg (fig. 2).

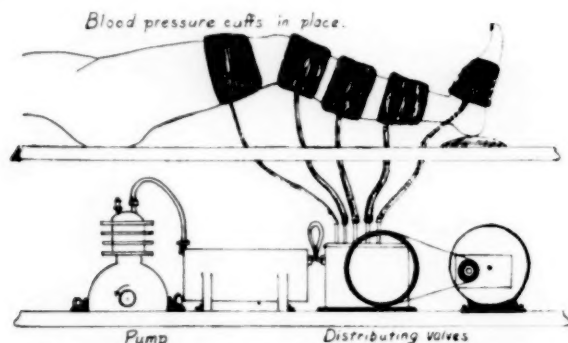


Fig. 2. — Diagram of the multiple blood-pressure cuff unit.

The cardiac output was found to influence the flow of blood into the extremities when the arterial and capillary systems were opened, and veins dilated. A closure or partial closure of one of the large arteries usually greatly decreased the blood flow in direct proportion to the size of the occluded vessels.

Since the nervous system was believed not to be functioning, and one was actually dealing with denervated extremities, one could not study the influence of nerves on the circulation with any degree of certainty. The action of heat on the extremities was studied in order to see what the response on a denervated tissue would be. It was found that in normal appendages for each degree of temperature elevation of the perfusing solution there was about 8 per cent increase in the blood flow up to 40 degrees centigrade, while with more than 43 degrees a definite decrease occurred. Local application of heat to an extremity was much less effective. In diseased extremities heat had much less effect on increasing the blood flow. An experiment was carried out to determine what influence the method of iontophoresis might have on increasing the blood supply in the foot. It was found that normal extremities responded very well and there was usually a rather noticeable increase in blood flow with iontophoresis; but in diseased ones no increase in the blood flowing into the extremity was noted. This suggests that perhaps in legs with arteriosclerotic vessels fully developed anastomosis has already taken place, and iontophoresis could be of no great benefit. The influence of local occlusion was studied and it was found that one might occlude the blood vessels of an individual's leg at one point and cut down the blood supply immensely, while the leg of another occluded at the same point showed much less reduction in the blood stream. This suggests that anastomoses vary greatly in legs and when present make the reduction of the blood supply much less. We can say in general that obstruction below the knee will have less influence on the total blood supply to the extremities than will one above.

We have applied the principles outlined here to the treatment of 47 patients and have found that in both thrombo-angiitis obliterans and arteriosclerosis they are effective in increasing the blood flow (table 1). Table two is an example of results obtained in the first 11 cases of thrombo-angiitis obliterans. All patients were required to stop the use of tobacco. All except one were greatly improved and are well today.

TABLE 1. — *Patients With Arteriosclerosis Treated by Multiple Cuff Method*

Case	Age	Hours of Treatment	Days	Symptoms and Signs Before Treatment	After Treatment	Saline 3 Per Cent 100-300 C.C. Intraven.	Hyperthemia Local or IV. Typh.
1	60	55	40	I.C.* No pulse in rt. ft. or poplit. art.	Pain imp. Pulses greater.	12	Local
2	58	48	52	Pain at rest, both feet. I.C. at 2 blocks.	Pain relieved. I.C. at 8 blocks.	12	8
3	67	52	80	I.C. at ½ block. No pulses both feet.	I.C. at 8 blocks. Pulses same.	12	8
4	52	38	40	Pain rt. ft. No pulses, either ft.	Pain in rt. ft. disappeared.	10	7
5	62	58	100	Pain at rest. Ft. cyanotic. I.C. after few steps. Ulcer lt. gt. toe.	I.C. at 4 blocks. Rest pain gone. Ulcer healed.	20	
6	56	51	60	Pain at rest, both ft. I.C. ½ block.	Sl. improvement. relief of rest pain.	8	Local
7	67	37	66	Diabetic, rest pain. Pulses weak. I.C. at 6 blocks.	Improvement questionable. I.C. continued. Mentally confused. Unable to state clearly.	3	Local
8	70	33	45	I.C. at 2 blocks. Paresthesia over dorsum feet. No pulses.	Imp. No pain. Pulses present, but weak.	10	Local
9	55	52	90	Ulcer on lt. ft.	Ulcer healed. Cleanliness important factor in therapy.	7	Local
10	57	100	60	I.C. at 2 blocks.	Imp. I.C. at 20 blocks.	dilute 1%	5 Local
11	72	45	35	Pain. I.C.	Made worse. Block of nerves for relief of pain.	3	Local
12	64	140	70	I.C. at 2 blocks. Night pain, rt. leg. Numbness.	Improved. Relapse. Received therapy again with improvement.	12	10

\* I.C. is intermittent claudication; *imp.*, improved; *rt.* and *lt.*, right and left; *ft.*, foot or feet.

TABLE 2. — *Patients With Thrombo-angiitis Obliterans Treated by Multiple Cuff Method*

Case	Age	Hours of Treatment	Days	Symptoms and Signs Before Treatment	After Treatment*	Saline 3 Per Cent 100-300 C.C. Intraven.	Hyperthemia Local or IV. Typh.
1	55	54	60	I.C.† at 2 blocks. No pedal pulses.	Improvement. I.C. at 25 blocks.	20	8
2	42	48	36	Painful gangrene gt. toe rt. foot. I.C. at 2 blocks.	Healing. Lost I.C.	14	7
3	38	48	50	I.C. at 2 blocks. Rest pain.	Lost I.C. and rest pain.	10	6

(Cont. on next page)

\* "After treatment" includes time patient was under treatment and several weeks thereafter.

† I.C. is intermittent claudication; *imp.*, improved; *rt.* and *lt.*, right and left; *ft.*, foot or feet.

(TABLE 2. — *Concluded*)

4	50	28	40	Pain both feet. I.C. at 1 block. Cyanosis.	Improvement. Lost I.C.	10	6
5	44	35	30	Paresthesia, lt. ft. Pulses good.	Lost paresthesia. Improvement in walking.	8	3
6	47	42	55	Pain at night. Cyanosis.	Improved. Lost night pain.	12	6
7	42	42	55	Pain at night. Large ulcer, rt. ankle.	Leg finally amputated.		
8	45	50	40	I.C. at 3 blocks, redness and pain.	Improved, can walk 20 blocks. Comfortable.	12	6
9	27	48	84	I.C. redness, Cyan.	Loss of redness. Comfortable.	22	10
10	47	20	120	Pain and redness.	Imp. Loss of pain. Some numbness.	8	5
11	39	44	60	I.C. pain, redness.	Complete healing.	22	10

Arteriosclerosis presents a more difficult problem. The question of tissue resistance in this condition is just as important as increasing the blood supply. The removal of tobacco and the administration of insulin, thyroid, and escatin are important adjuncts from this angle. In severe arteriosclerosis with occlusion amputation may be the only method of choice. Drugs rated as vascular dilators have in our hands been useless, except possibly alcohol, which reaction resembles mild application of heat.

### Summary

We suggest for the treatment of diseased extremities a combination of factors, such as intravenous saline 3 times per week, venous congestion, daily for a period of 5 to 6 weeks. The use of blood pressure cuffs timed to squeeze the blood downward into the extremity, over a period of a 4-minute cycle, is of benefit. The use of heat in the form of typhoid vaccine, local heat therapy, or alcohol three times a day is definitely beneficial. The use of alcohol is indicated in elderly patients. Increasing the heart output and local tissue metabolism by the use of thyroid substance, insulin, and escatin, is a valuable measure.

(For discussion see page 168)

## DIAGNOSTIC PROCEDURES FOR PERIPHERAL VASCULAR DISTURBANCES \*

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The present therapeutic methods for peripheral vascular disease have proved most effective where applied during the incipient stage, and least promising when employed at a time when grave organic changes have already become apparent. It follows that to be of greatest help to patients, this condition must be recognized at an early period, that is, before the development of pronounced symptoms and palpable changes. Physicians often are consulted for vague symptoms of a circulatory or metabolic nature

\* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 13, 1938.

which may suggest the possibility of disturbance of the peripheral circulatory apparatus. It is in this class of cases that we are obligated to resort to all available diagnostic measures with a view of establishing the presence or absence of the type of affection under consideration.

This involves a thorough physical examination and the obtaining of a detailed history which should include the following data:

*Family History.* — Inquiry should be made about arteriosclerosis, diabetes mellitus, angina pectoris, heart disease and syphilis among the patient's progenitors.

*Past History.* — This endeavors to obtain causative or predisposing data by inquiring about syphilis, tonsillitis or other possible foci of infection, injuries, frostbite, phlebitis, symptoms suggestive of diabetes, hypertension and paroxysmal tachycardia.

*Present Status.* — It is of great importance to obtain the chronologic data about an onset of intermittent claudication and its appearance after a distance covered by walking or climbing. A history of operation for an ingrowing toe-nail, removal of calluses is often significant. The date when ulceration or gangrene set in must be ascertained. The patient should be asked about the nature, degree and duration of pain in the extremities with relation to rest in bed and intake of food. It is important also to ascertain whether pain is brought about by change of posture or use of an extremity.

The occupation should be investigated since some vocations involve exposure to chemicals, gases, radium, paints which are predisposing factors. The same holds good for personal habits with particular reference to the abuse of tobacco and alcohol.

A systematic physical examination should follow, including the more common methods of search for peripheral vascular disturbances. After inspection of the extremities one should establish their level of optimum circulation with the patient in the recumbent and in the sitting position. It should be determined whether the walls of the large arteries are fibrous, diffuse, senescent, corrugated or calcified and whether the pulse can be felt in the dorsalis pedis and posterior tibialis. Blood pressure should be taken of both arms but NOT of the legs. One should ascertain by clinical or roentgenologic evidence the presence of a cervical rib or ribs. The volume of the pulsation of all the major peripheral arteries is next determined by palpation (grade the pulsation one plus to four plus). An exact record should be made of the extent and nature of any infection, lymphangitis, ulceration or gangrene.

Changes in the color of the skin are not essential for a diagnosis of impaired peripheral circulation because experience has shown that definite symptoms may precede discoloration. In at least three cases seen during the past year with a chief complaint of "a feeling of numbness" there was no color change at all, yet they had very definitely a limited peripheral circulation which was greatly benefited by treatment.

In attempting to differentiate between truly organic lesions, the vasospastic condition, or a combination of the two, many diagnostic aids have been described. Drugs have been used, both for diagnosis and therapy; the more commonly used ones being, amyl nitrite, sodium nitrite, pentothal of sodium, typhoid vaccine, acetylcholine, histamine, papavarine and mecholyl. The "constant temperature room" described by Herrmann is used to determine whether or not the patient's own body heat will release the spasm of the vessels in an extremity.

Plethysmographic readings are used by Collens and Wilensky, to determine the degree of vasospasm and as a prognostic measure. They have also given us the two new tests, namely, (1) the venous filling time and



(2) the claudication time. Turner has refined the use of the plethysmograph, so that he can show graphically the circulation as demonstrated by the pulse in each finger or toe.

Arteriography as used by Veal and Horton plays a very important part in diagnosis and prognosis. Some feel, however, that it is inadvisable to inject contrast media into already changed arteries.

Every one who sees a number of a certain type disturbance develops some technic. The one which I have often used as a diagnostic aid is the pavaex unit applied for an hour or two. The extremity is studied with the oscillometer and the oscillometric curve may be almost normal. Lacking time and opportunity to study the patient with all the above mentioned procedures, his extremity has been placed in a boot and given an hour or two of treatment. If he has freer motion of the foot, the temperature is increased and the symptoms are relieved, the patient is advised to take a series of treatments.

### Technic

*Position of the Patient.* — The relative position of the affected extremity with respect to the level of the heart during the passive vascular exercise is extremely important. Usually, the most convenient position for the patient is flat on the back with the extremities to be treated elevated eight to twelve inches above heart level. Occasionally, in elderly people it is found advisable to permit the patients to shift most of their weight to the side of the treated extremity. They may also have some elevation on a back rest, but then the extremity must be elevated more than when the patient is in a flat position.

*Care of the Skin of the Thigh.* — Utmost attention should be given to the skin of the thighs at all times, and under no circumstances should any abrasion due to an improperly fitted cuff be left untreated. The judicious use of alcohol and hamamelis hardens the skin and renders it less vulnerable. Before applying the cuff to the thigh, the entire leg should be carefully dried without rubbing, then borated talcum powder should be dusted over the skin surface. Gentle massage of the skin and muscles of the thigh should be carried out immediately after the boot has been removed.

*Application of the Cuff.* — After the skin of the thigh has been properly prepared, an auxiliary sleeve of the proper size is selected and applied to the middle third of the thigh. The metal adapter of the cuff assembly is slipped over the foot of the affected extremity, and the small end of which is attached to the rubber sleeve is directed toward the groin. The thin rubber sleeve is then applied as high as possible over the thigh. Care must be taken that no constriction of the superficial veins results from the application of this sleeve. The rubber should simply lie in approximation with the skin. The metal adapter is applied up over the portion of the sleeve which has been adjusted to the thigh and in this manner a double fold of the sleeve forms on the inside of the metal adapter. The thigh is then gently forced into the cylindrical end of the metal adapter to take advantage of the natural corking action of the thigh. Care must be taken to have the part of the sleeve around the thigh extend at least one inch higher than the proximal rim of the metal adapter. If this detail is not observed, the seal between the thigh and the cuff assembly will not be satisfactory.

After the cuff assembly has been properly fitted to the foot, the extremity should be inserted into the boot and the metal adapter attached by means of the two clamps. This provides an air tight seal between the cuff assembly and the boot. If there is a tendency for the boot to slide back

and forth it should be fastened to the foot end of the bed. The weight of the patient's body will prevent the extremity from moving back and forth.

As previously stated, the use of the pavaex unit for an hour or two may definitely show whether or not an extremity has any deficiency of arterial blood. Care should be taken that the apparatus is properly adjusted as otherwise the results may be disappointing or even aggravate the condition.

### Conclusion

All will agree that the earlier the diagnosis is made, the more efficacious will be the conservative treatment. This is attainable by systematic physical examination and also by the proper interpretation of rather vague symptoms, such as areas of numbness of the feet or legs, the early signs of intermittent claudication, and realization that in certain occupations the individuals early develop degenerative changes.

*(For discussion see page 168)*

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## THE PARAFFIN BATH IN PERIPHERAL VASCULAR DISEASE \*

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The paraffin bath has been more or less restricted to the treatment of traumatic and osteo-arthritic conditions. As far as we can ascertain from the literature of the past five years, it has not been employed in the treatment of peripheral vascular disease.

One of the main problems in the treatment of peripheral vascular disease is the production and maintenance of heat to the affected parts. Furthermore, preservation of the texture of the skin is essential, especially for the prevention of dryness. This has become possible, to a great extent, by the use of the paraffin bath.

This method was adopted because we believe that it was based upon sound physiologic laws, as the results obtained have proved. The mechanism of hyperthermy has been thoroughly investigated, and reported by Bard, Krogh, Lewis, Landis, and others.

It is a physiologic fact that the body temperature represents a balance between heat production and heat loss. Heat loss in man is effected partly through the respiratory tract, but chiefly through the skin. Through the latter pathway heat is lost by the physical processes of heat conduction and radiation and by the evaporation of sweat. In the lungs it is lost mainly through evaporation. It is obvious that the proportion of heat lost through the body by the process of radiation, convection, and evaporation is determined by the temperature of the skin and surroundings, the moisture in the air, and the movement of the air over the respiratory surfaces. The temperature of the skin, of course, depends on the rate at which the blood is circulating through the cutaneous vessels. It has likewise been proved that the afferent impulses, which reflexly control the change in the cutaneous circulation, may be set up by local applications of heat and cold.

When constant heat is required for a long period, say two or three hours, it has been found that the application of the paraffin boot, properly

\* From the Peripheral Vascular Clinic, North Side Unit, Youngstown Hospital Association.

\* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 13, 1938.

insulated, to the extremity opposite to the one involved, produces a reflex rise in temperature and an increased volume of blood, (if the extremity involved), of 2 to 3 F. at the onset and increased oscillometric readings 1 to 3. After one-half to one hour there persists a one degree rise in temperature and oscillometric reading 1 to 2 throughout the course of the treatment. These results were verified by graphic oscillometric and surface temperature readings made at various periods during treatment.

When patients come to the clinic after having been exposed to outside cold atmospheric conditions, the limbs are cold, blanched, and the veins are constricted. The routine application of our physical therapy requires a comparatively long time to warm the limbs and effect a response to treatment. If a preliminary treatment of the whirlpool bath (fig. 1) at 110 F. is given, followed by an application of the paraffin boot, the extremities are warmed and respond more quickly to the therapy, irrespective whether intermittent venous compression (fig. 2) or suction-pressure is used. This quicker



Fig. 1. — Whirlpool bath to lower extremities. Case of osteoporosis of foot following fracture of calcis.

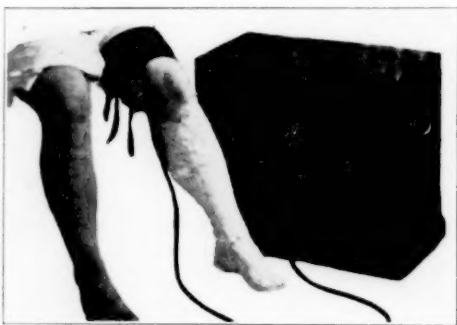


Fig. 2. — Application of paraffin boot and intermittent venous compression cuff (Collens-Wilensky).

response to therapy was also proved by oscillometric and surface temperature readings of the involved parts taken before, during, and after treatment.

In the routine management of peripheral vascular disease, especially thrombo-angiitis obliterans, arterio-sclerosis obliterans (senile and diabetic), frost-bite, and ergot poisoning, we apply the paraffin boot to an uninvolved extremity in order to obtain reflex dilatation and an increased blood supply in the diseased limb. To prove that this is obtained, we made oscillometric and surface temperature tests, the latter showing within fifteen minutes of its application that there is an average increase in surface temperature reading of the opposite extremity of 2.8 F., and increased oscillometric reading averaging a  $2\frac{1}{2}$  degree rise. Readings taken every fifteen minutes for a period of one hour show a maintained rise of one degree in surface temperature and of one point in oscillometric reading at the end of one hour. This increase was not obtained in cases when paraffin boots were not used during treatment. In patients who received routine therapy alone, notwithstanding the fact that they remarked they felt better after treatment, the limbs became cold after two or three hours. In the cases subjected additionally to the paraffin boot, the limbs remained warm and comfortable four to six hours.

In patients with various ulcers or thrombo-angiitis obliterans who were subjected to iontophoresis of acetyl-beta-methylcholine chloride (mecholy), the response was shown to be improved by the immediate application of paraffin. This kept the cutaneous reaction of pilomotor stimulation and warmth from four to six hours. Again these reactions were tested as in the other types of therapy.

When the oscillating bed is employed plus intermittent venous compression, application of the paraffin bath produces similar results in that there occurs increased surface temperature and oscillometric readings.

In the winter months the affected parts are also given a paraffin coating. The limb is then subjected to therapy. Formerly while subjecting the extremities to intermittent venous compression, they were placed in a water bath, with temperature thermostatically maintained at 100 to 110 F. Insulation was obtained by wrapping the foot bath and the limbs up to the hips with a heavy blanket. This exposure caused a great deal of water-logging and excoriation of the skin. When these patients were exposed to low atmospheric temperatures on removal from the bath, their limbs quickly became cyanotic. Since the adoption of the paraffin application this has been obviated.

### Technic

Where the lower extremities are involved, the arms are inserted in the bath as far above the elbows as possible and coated with six to eight layers of paraffin at 110 F. (This temperature is obtained by the use of 12 ounces of paraffin oil to one pound of paraffin, heating same to the melting point of 110 F., and requires from one to one and a half hours.) The arms are then wrapped with wax paper and covered with blankets. The whole part is covered with electric pads in the form of muffs, the temperature of which is thermostatically controlled at 96 to 110 F. This application is kept up throughout the treatment by intermittent venous compression or suction-



Fig. 3. — Application of paraffin in various ulcers and post-injection of varicose veins, after ligation of the long saphenous vein. This covering is wrapped with wax paper strips, 3 inches wide, and then gauze or elastic bandage.

pressure. The same procedure is followed in performing the Landis test for reflex vaso-dilatation. When the arms are affected the legs from the mid-nigh down are submitted to the paraffin treatment. After application of the paraffin and its coverings, we also use a cradle vasculator which covers the body from the hips down. Within the vasculator there is a unit producing thermostatically controlled heat by convection, the temperature averaging between 96 and 100 F. The cradle is well insulated with blankets all tucked under a mattress about the patient's hips.

In the treatment of varicose veins complicated by ulcers or chemical phlebitis (post-injection), the skin condition presents a problem. To keep it soft and moist, the extremity is coated with paraffin, then covered with wax paper and blankets, and subjected to further treatment as required, which generally is intermittent venous compression, (Collens-Wilensky, fig. 3).

Patients with eczematous conditions following venous injection receive a coating of two or three layers of paraffin. This is then covered with wax paper and bandaged with gauze or elastic bandage and worn for twenty-four hours. By this method the feet not only remain warm, but the patients can walk better. Attention is called to the fact that exposure to severe cold results in caking of the paraffin which can be softened again on arrival home by exposure to an infra-red lamp, electric pad, or hot water bottle for fifteen or twenty minutes.

### Discussion

One of the chief problems in the treatment of peripheral vascular disease is the necessity of conserving heat and promoting increased hyperemia to the affected parts. This is best obtained by the use of the paraffin bath, which produces and conserves heat for a prolonged period depending on the length of time of application. Previous to the employment of this method the patients with cold extremities complained of pain (increased spasm) on initiation of intermittent venous compression or suction-pressure. Since the adoption of this new method of treatment, either by direct or reflex application, the limbs were made warm, treatment did not induce pain and could be tolerated for a much longer time. At the cessation of treatment surface temperature and oscillometric readings show an increase in heat production and volume of blood and circulation in a shorter period than when the paraffin bath was not employed. Tests were made after fifteen minutes, one-half hour, one hour, and two hours, taking surface temperature and graphic oscillometric readings.

In the treatment of varicose veins when eczema and ulcer exist, and ligation and injection had been performed, the skin condition improves. Periphlebitis, produced by the chemical reaction of the injection and the granulations about the ulcer show improvement much more quickly when paraffin applications have been employed. Where ulcers existed on both legs (five instances), one leg was treated with the paraffin bath and regular therapy, and the other leg according to former methods only. The observations of the results convinced us of the desirability to make the paraffin application a routine procedure.

### Conclusion

1. The paraffin bath is a valuable adjunct in the treatment of peripheral vascular disease because it stimulates local hyperemia, reflex vasodilatation, and prevents loss of heat by evaporation.
2. It improves the condition of the skin, as it renders it soft and pliable, so that increase in the circulation of the capillaries and arteriovenous anastomoses can be brought about more readily.
3. Subjectively improvement is acknowledged by patients to be greater with the paraffin application, as compared with other procedures.

### Discussion of the Papers of Drs. Harpuder,\* Kountz, Merrell and Sedwitz on Peripheral Vascular Disease

**Dr. Geza de Takats** (Chicago): The papers here presented all have a very significant trait in common, in that they place certain therapeutic procedures on a sound, physiologic basis. This must be required of all procedures, if physical or pharmacotherapy wishes to emerge from the fads and fallacies to open daylight of scientific medium.

In regard to venous occlusion by ligature or cuff compression, the rise in venous pressure and the filling and stretching of the venocapillary bed seem to be the important factors. We routinely tie the concomitant vein whenever a large artery has to be tied and are convinced that the incidence of gangrene is thereby lessened. Especially useful in this principle whenever the carotid artery needs to be tied. However, maintenance of a high venous pressure can be easily accomplished by cuff compression. Dr. Harpuder has just stated that a mild passive

hyperemia is as effective as the intermittent venous hyperemia. This is undoubtedly true, if one feels as Dr. Kountz does and as we have always maintained, that the mechanical phase of stretching the venocapillary bed is as important as the chemical phase in producing reactive hyperemia. I notice that Dr. Harpuder did not use pressures higher than 40 millimeters of mercury. With such a mild congestion, reactive hyperemia is not to be expected, as no appreciable debt in oxygen is created. That higher pressures, such as 80 millimeters of mercury do produce a reactive hyperemia, can readily be experienced by anyone who feels a wave of warmth passing down his leg after one or two minutes of higher venous compression.

The real objection, however, to prolonged passive hyperemia in the treatment of peripheral vascular disease is that favorable conditions are produced for the production of venous thrombosis. Whether one is

(\*Article by Dr. Harpuder appeared in January, 1939 Issue. — Ed.)



treating an arteriosclerotic or a thromboangiitic limb, stasis and concentration of the blood are produced, both of which favor thrombosis. The value of intermittent venous hyperemia, in which periods of constriction, not lasting over two minutes are alternated with periods of release and in which the elevation of the leg is added to empty the venocapillary bed, lies just in the fact that falling and stretching is permitted only until it reaches its maximum intensity, within one or two minutes after which it is released.

A small group of 35 cases has been carefully studied and kept under observation following the use of intermittent venous hyperemia and using the method described from our clinic. In this form of treatment, just as with suction and pressure therapy or following sympathectomy, it is the stage of the disease which is the most important factor in obtaining favorable results. Patients with rest pain or frank massive gangrene derive slight or no benefit from any of these conservative measures.

Dr. Kountz's ingenious multiple cuff method again emphasized the importance of a patent and full terminal vascular bed. The addition of hypertonic salt solution and fever therapy is a happy combination of methods which are known to increase peripheral circulation. We use these methods in our clinics in Chicago, but are still not certain that a single cuff is not equally helpful in maintaining high venous pressures.

I have enjoyed listening to Dr. Merrell's paper and fully agree with his conclusions. I would only question the use of one pavaex treatment as a therapeutic test; in questionable cases, we prefer to give 10 treatments to see if any benefit is obtained. The subjective response of the patient to one treatment is deceiving and the rise of surface temperature may occur in patients who only receive sham treatment. But as Dr. Merrell has properly emphasized, if the stage of the disease is not too far advanced, results may be expected from peripheral vascular exercise in direct proportion to the degree of structural involvement.

I have no experience with the use of paraffin-baths in the treatment of peripheral vascular disease, although this treatment is frequently used in our group at St. Luke's hospital for other conditions. Dr. Sedwitz described a nicely balanced combination of whirlpool baths, reflex vasodilatation by a paraffin bath, suction and pressure, intermittent venous hyperemia and, in suitable cases, mecholyt-iontophoresis and the oscillating bed. The use of the Collens-Wilensky apparatus in the treatment of periphlebitis indurations is not without danger. An increase of inflammatory reactions and a rise in temperature are more than a theoretical possibility. I agree with Dr. Sedwitz that any mechanical device, such as suction and pressure apparatus or intermittent venous hyperemia is more effective when maximal vasodilatation has been accomplished. It is for this reason that patients suffering from Buerger's disease respond so much better to these treatments, when sympathectomy has abolished all reflex vasoconstriction. But I would hesitate to adopt this array of measures unless it could be shown that a large

heat cradle placed over the entire body is less efficient. From the standpoint of time and cost to the patient, the simplest is always the best form of therapy.

**Dr. Madge C. L. McGuinness** (New York): It seems to me that most peripheral diseases are found in patients who have diabetes or the various blood diseases which if treated early would obviate the distressing sequelae associated with peripheral vascular symptoms. They should not be allowed to advance to the stage where surgical intervention is a matter of necessity.

In practice and in my clinical material I have advocated a cooperative setup composed of a surgeon, clinician and physical therapist—a triad to study these cases and prevent the ultimate results which we often see when it is too late to do anything. I hold with Dr. Merrell, if we have an early diagnosis we would be much better off and so would be the patient.

Closely related to the matter of heat therapy is preventive therapy in the form of climatic control or supervision. These vascular cases as has been shown apparently are more comfortable in a climate of from 90 to 95 F. with a humidity of about 75 per cent. And therefore a suggestion has been made that if they could dwell in such a climate and be exposed to its salubrious influence from two to five weeks, so much the better. If they cannot live there all the time, why not have, besides the conditioned rooms that are now introduced into some hospitals, a room built for these patients especially, or a small sanatorium? Now, with air conditioning being built in, it would be a practical idea for people so afflicted to have their rooms environmentally conditioned. We have found with the optimum temperature of 90 to 95 F. and 70 per cent relative humidity that there will be a marked drop in blood pressure, both diastolic and systolic. With that drop there follows favorable reactions on their symptoms. There is a lessening of the development of sclerosis. There is a marked vascular relaxation especially in cases of hypertension. There is less vascular spasm, and when we no longer have such vascular spasm we have less nerve tension.

There is one common neglect that must be corrected; namely, that patients coming in from cold and wet streets or homes should be prepared for treatment at least an hour or two beforehand. I have seen them waiting from three to five hours. Their constant complaint is, "My feet are cold and numb. Why can't I have this heat?" Whatever is the treatment, it must be prompt. If they are in the hospital we prescribe vasculatory exercise, thermostatically controlled. This is often administered for 24 hours, which gives them a degree of comfort difficult to duplicate, and hence is worthy of serious consideration as better than some of the palliative and complicated measures advocated in the past.

**Dr. Karl Harpuder** (closing): The possibility of the development of thrombophlebitis with the application of passive hyperemia is certainly present. I have

treated altogether something like 30 cases of peripheral vascular disease with passive hyperemia and I haven't seen a single complication of thrombophlebitis, but that may be just a coincidence. I don't believe the danger is much greater with Bier's hyperemia than with intermittent passive hyperemia.

So far as the height of pressure applied, we deliberately have chosen pressures not higher than 40 mm. We thought that the

maximum therapeutic effect upon the capillary circulation should be accomplished with a pressure of 40 mm. because the capillary pressure is less. If we employed higher pressure we probably would interfere with the arterial circulation. The appearance of reactive hyperemia during intermissions, as a matter of fact, is a sign of anoxemia in the tissues during the period of stasis because reactive hyperemia is a result of insufficient nourishment

*(Concluded on page 180)*

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## CERTAIN BIOLOGIC EFFECTS DURING ARTIFICIAL FEVER \*

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The purpose of this communication is to present additional features to studies on artificial fever which we began some years ago. Considerable interest has been recently aroused in artificially induced therapeutic fever. Numerous claims have been made for its clinical results, but little attention has been paid to the changes which take place as a result of hyperthermia in the body economy in health and disease. In previous communications at the International Congress on Fever Therapy, Gibson, Kopp and myself described such changes in the human subject during hyperthermia. The nature of our communication at that time was in respect to water balance and electrolyte change. It was emphasized that if severe reductions in plasma volume were allowed to occur as a result of dehydration, vascular collapse was a potential danger. The prevention of shock due to this particular phenomenon depended upon the administration of fluid in amounts sufficient to prevent loss of tissue fluid. It should be remembered that an increase in environmental temperature brings about at least two important changes in the intrinsic function of the body—sweating and hyperventilation due to an increased respiratory rate. The degree of sweating can vary from minimal sweat loss in hot water baths to that lost in extreme dry heat.

During sweat loss electrolytes are eliminated through the skin, the principal ones being the chlorides. These exist in varying concentrations but are always present irrespective of the degree of sweating. Thus in 1878, a British naval surgeon advised the use of salt solution in the treatment of heat exhaustion. Since that time numerous studies have been undertaken to show the relationship of sodium chloride loss to heat cramp and it has been demonstrated beyond any doubt that the addition of this salt to the drinking water will definitely prevent this condition.

In artificial hyperthermia the importance of the loss of chloride has been emphasized by Fishberg, Simpson and others. The most complete studies of Warren reveal, furthermore, the relationship of chloride loss to chloride reserve. It was this investigation which chiefly prompted the administration of large quantities of sodium chloride previous to induction of hyperpyrexia in patients and which plays an important role in maintaining an adequate chloride balance during treatment. Thus during the process of sweating not only is body water lost but chlorides as well.

Aside from the loss in chlorides during artificial fever other changes involving the acid-base balance take place. Warren, Burman and Nasset, Bishop

\* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 12, 1938.

and Warren have described the extreme degree of hyperpnea which results in a considerable loss of carbon dioxide from the blood. Such a loss would be a factor in inducing the blood pH to become more alkaline. Furthermore Bierman has pointed out that the most severe degree of alkalosis known has been in patients subjected to artificial fever therapy. The work of Cajori and his coworkers would indicate that there is a slight increase in the alkali reserve. Bischoff, Long and Hill, in studying the acid-base equilibrium in hyperpyrexia induced by short radio waves, noted significant shifts of the pH of the blood to more alkaline levels. They further attempted to calculate an increase in alkali reserve noted by Cajori by measuring changes in blood volume on the basis of an increase in oxygen capacity. This method of measuring the blood volume is grossly inaccurate since, as has been previously noted, slight increases in the total red cell volume may occur during artificial fever, but the real error lies in there being a definite increase in oxygen capacity during fever which, as Goldfeder has shown, and we have confirmed, the venous hemoglobin becomes highly oxygenated.

In artificial hyperpyrexia the hyperpnea which takes place plays a great factor in the resulting electrolyte changes. Thus Grant and Goldman, and Davies, Haldane and Kennaway have presented evidence that a respiratory hyperventilation occurring during fever induces an elevation of the blood pH and a lowering of the bicarbonate concentration. In this respect we were able to confirm this work. In hot baths where the evaporation of sweat from the skin is minimal, Hopkins conclusively demonstrated that the hydrogen ion concentration of the blood rose to a pH 7.55.

This was about as far as we had ventured two years ago with respect to the findings in these two changes. In the last year, however, with the help of others we were able to investigate further into the causes responsible for the severity of the alkalosis and dehydration. This work has been based on the factors of *heat assimilation* and *heat loss* by the body.

For the purpose of clarity let me develop the idea of this phenomenon. In the production of artificial fever in the human subject there occurs heat assimilation and heat loss. Irrespective of the device employed to produce fever these two mechanisms are always involved. Heat loss takes place primarily through the skin and lungs. Through the lungs it is lost in the expired warm air and in the water vapor of this air. Our first suspicions were in the direction of some kind of relationship between environmental heat and humidity and of changes taking place in the body, with this relationship being a basic one. If the artificial fever is induced by an elevation of general environmental heat the temperature of the skin and certain subcutaneous layers become higher. We have repeatedly noticed that when this takes place the respiratory rate in the patient increases, and it would appear that this result of panting is partly for cooling purposes. This seems most reasonable when we consider that heat loss from an extreme temperature through the skin is inactive so that loss must occur through panting. In dogs, which do not sweat, heat loss is performed by this panting procedure.

#### **Relation of Environmental Heat and Humidity**

In bringing out this concept of the environment in relation to heat it would appear that even though the rectal temperature is maintained by general environmental heat at 106 F. the severity of this thermal relation is lessened if the environmental temperature is not markedly elevated but remains low. Not only is the alkalosis mild but the degree of hematocrit change is minimal and within 7 per cent of the original value. We can safely say, therefore, that the dehydration does not exceed 7 per cent. Let us remember that the degree of change in the hematocrit occurring during fever closely parallels the degree of tissue dehydration taking place as evidenced by the intensity of sweating and water loss. It

has occurred to us, as it has occurred to others in the past, that if the heat loss from the body could be prevented the degree of environmental heat necessary to maintain a fixed body temperature would be reduced. This point which at first was thought to be relatively insignificant became of importance as we were able to clarify our concept completely. Thus if the evaporation of sweat could be prevented and the cabinet temperature and conditions would be such as to prevent heat loss from the body, the degree of dehydration and alkalosis would be reduced. In this respect I must call attention to the following findings. Two years ago Gibson, Kopp and myself noted that patients receiving fever with a cabinet temperature of 140 F. with a humidity of 40 to 50 per cent and a rectal temperature of 106 F. with a maintenance time of six hours developed a pH change of the blood of 7.63 and a degree of dehydration of 15 to 20 per cent. Subsequent to this Payzant and I observed in a patient who received fever in a cabinet with a temperature of 120 F. and a humidity of 75-80 per cent and who obtained a rectal temperature of 106 F. for six hours maintenance, had a pH change from basal to 7.59 with a degree of dehydration of 9 to 14 per cent. With the assistance of Dr. Snow several patients were studied in which the temperature of the cabinet was from 106 to 112, the humidity 95 to 100 per cent and the rectal temperature 106 F. at a session of six hours with a change in the blood pH to 7.52 and a degree of dehydration of from 4 to 6 per cent. Without going into great details of our study and the presentation of changes of individual electrolytes it must suffice to state that at 100 per cent humidity we have been able to hold a patient at 106.8 F. for eleven hours and could conceivably have prolonged the procedure.

A criticism can be brought forward in respect to the presentation of these simple data in that different cabinets were employed with different quantities of air space and different rates of circulation of air in each one of these experiments. We must state that we were able to reproduce the data by the use of one single cabinet in which all the changes of humidity and temperature could be arranged from complete dry air to complete humidity with a minimal degree of air current which was always controlled in each instance. It was found with this cabinet that shock occurred when the humidity was low and the temperature high, and conversely smooth treatment was attained when the humidity was high and the temperature low. Thus if the evaporation of sweat can be prevented during fever and the cabinet temperature and conditions be such as to prevent heat loss from the body the degree of dehydration and alkalosis would be reduced.

Furthermore, the temperature of the skin and the drawing-out process from the skin would not be as marked with a lower environmental temperature. If a cabinet contained only dry hot air and had fans blowing this air over the patient, the heat loss from the body would be considerable and physiologic changes intense.

Time does not permit me to discuss all details of our study because the simplicity of this method of fever treatment rests on the emphasis of high humidity and low temperature. It would appear from what I have said that in the past two years we have merely clarified one further advance in the application of hyperpyrexia. Those who are cognizant with the laboratory difficulties of this type of experimental work will realize the reason for slow progress.

### Discussion

**Dr. William Bierman** (New York): Fever therapy by physical means came into use a little less than a decade ago. Observations were made during these years, and gradually the understanding of what occurs in the way of physiologic change is becoming clearer and clearer. We have come to the realization that it is advisable to pay attention to the degree of humidification in the cabinets for the

administration of fever therapy. The essayist has presented facts carefully observed over a sufficiently long period.

The idea of using complete humidification, or complete saturation of the environment surrounding the patient whose temperature we aim to raise, is not a new one. As a matter of fact some of the earliest work was done near here, in Ohio, by Phillips, and if my memory serves me



in good stead the report of his work appeared toward the end of the last century. He employed the hot water bath, which is as completely a saturated environment as one could possibly apply. Unfortunately his observations which called attention to this particular procedure received but scant notice, so that in the ensuing years we find no reference to the employment of physical measures for the elevation of body temperature as a method of treatment.

Subsequently other workers used the same type of technic. I have in mind particularly the reports of Mehrtens and Pouppirt which appeared in the *Journal of the American Medical Association*. I believe that those workers used a water temperature of about 110 F. The impression which appears to have been made upon those of us who are interested in fever therapy is that this was a dangerous method of elevating the temperature and maintaining it. There were reports of several deaths, and so the impression was gained that while a very high degree of humidification, as exemplified by the water bath, might be a desirable method of elevation of temperature, it might not be as desirable, judging it from the purely clinical point of view, in its maintenance.

We have conducted a large number of such applications in an effort to determine the optimum method of creating physically induced fever, and we observed a very large percentage of occurrence of tetany in the cases in which we used the water bath. We observed that the temperature could be elevated very rapidly, much more so than by any procedure which we have used either before or since. We noted that it was not necessary to raise the temperature of the water very high.

Dr. Pijoan states that it is necessary to maintain the temperature of the bath, or else I heard him incorrectly, that it is necessary to raise the temperature of the water to about 110 degrees. We never went that high. In our technic we immersed the patient in water of a temperature of about 102 F. and increased the temperature of the water 1 degree every five minutes. I do not recollect that we ever went beyond 108 degrees. It is my recollection that the temperature of the body can be raised to a level of about 106 when the water bath temperature is no higher than 107 or 108 degrees.

We gave up this method of temperature elevation because of the common incidence of tetany and of the great discomfort to which we appeared to subject our patients. One of the conclusions we therefore drew is that it is possibly inadvisable to use the most efficient method which we can apply in the elevation of temperature, because its rapidity might be a factor. I wish Dr. Pijoan would explain why the rapidity of temperature elevation seems to be a factor, one which apparently has not received very much attention in the past.

I want to ask two other questions: One is if air motion is inadvisable would it be preferable to use a cabinet in which no arrangement is made for air motion? I

realize that it is practically impossible to prevent air motion in any heating system with differences of temperatures within various parts of the cabinet. It is difficult to prevent the motion of air where no particular device is incorporated to insure such air motion. I, therefore, put the question whether it isn't better to avoid any fan, or some other such device designed for the production of air motion if that is possible.

The other question is concerning the consideration of the prevention of heat loss. It is obvious that if it were possible to conserve heat energy, that would be the advisable thing to do because the body would then be put under less stress and strain. We attempted to do that early by medication. We employed a hydrobromide with the dual aim of sedation and prevention of heat loss. We observed that for a time subsequent to the injection of small quantities of hyoscin hydrobromide the skin remained relatively dry, that is, perspiration and sweating were decidedly interfered with. That was our method of attempting to accomplish that idea. We still use it, as a matter of fact, but because hyoscin is a dangerous drug we do not repeat the application at frequent intervals, nor do we use any except very small doses.

**Dr. Kenneth Phillips** (Miami, Florida): The human body is equipped with a heat regulating mechanism, and normally and physiologically the skin is cooler than the internal temperature; therefore, any apparatus that will adhere closer to that mechanism in my opinion has always been more appropriate.

I am particularly interested in the pH factor. Personally it has not been my experience to witness this emphasis on hyperpnea that we see so often, and I think a great deal of that is again due to the method of production of fever. I do not think that one can place a human body into an oven and expose it to a condition simulating a roast with the possible exception that blood circulates. The essayist has shown that in a cabinet with an essentially dry temperature of 140, with 40 per cent humidity, there was an 18 to 20 per cent change in pH. When he reversed that and had his cabinet running at 106 F. with essentially 100 per cent humidity, he received only a 4 to 6 per cent change. It has been my opinion that the pH of the blood and many of these biologic changes are due to the method of production. Chloride loss none of us doubt any longer. None of us are particularly puzzled as to how to control it. Between 1932 and 1935 we treated a series of cases on the carbon dioxide combining power of alveolar air. When these patients were in a high humidified environment we did not get the same change as we did when they were put in the so-called dry heating, baking types of apparatus.

**Dr. Michel Pijoan** (closing): Concerning air currents, I believe air currents should be minimal. That is to say, there should be no great current of air. If air has to be supplied to the cabinet in order to carry heat and moisture it should be



admitted only in sufficient amounts as is required to keep the body temperature constant and containing a high degree of humidity. Dr. Phillips raised the question regarding the measurement of alveolar air. I, too, am interested to

know how the CO<sub>2</sub> combining power is done on alveolar air because I have never heard of such an assay. All of our work was done on plasma, and no CO<sub>2</sub> determinations (content) were carried out on alveolar air.

## Chronic Myositis of Lumbar Region — Report on Studies of Fever Therapy\* — Shorbe

### Discussion

**Dr. H. J. Behrend** (New York): It is true that in myositis of the lower spine, it is not the injury itself that prompts the patient to stay away from his work for a long period of time, but the secondary pathologic involvements of the muscles concerned are found in a state of tenseness or spasm. This may be due to static changes because of the injury of the spinal column, or to locking of the sacro-iliac joint, or of one of the joints of the lumbosacral junction as described by Mennell. The muscle condition on the other hand may be the consequence and a symptom of an infectious condition, a series of which Dr. Shorbe has brought to our attention. The fact that so many of these cases were found positive to undulant fever agglutination and intradormal tests is indeed very surprising. However, there is also one case described with a negative undulant fever test and low grade fever. It occurs to me that this is one of the frequently observed cases of infectious arthritis or peri-arthritis, where the trauma has caused a dormant infection to flare up and to manifest itself in the *locus minoris resistentiae*.

As to the therapy, I do not know whether we should resort to such a serious method as artificial fever. I fear that the raising of a patient's body temperature to 106.2 F. as in case No. 4, might lead to an increase of his claims before the adjusting commission, if he is able to appear in person. To my personal experience the treatment of even mild cases of infectious arthritis or myositis with fever therapy is not encouraging at all. But I have to admit that I have no experience in treating cases of *Brucella* infection. It is extremely interesting that case No. 2, to whom a fever treatment of only 101.6 F. for six hours was given, has recovered so quickly. I have seen similar results in similar cases. All we have to expect from fever therapy in these cases is a stimulative action on the defense mechanism of the body. We are able to achieve this with applications of physical therapy, especially hydrotherapy, which are milder and much less dangerous than fever therapy.

When hyperpyrexia has been suggested as a method of treatment in an effort to avoid the dangers of stretching, I would like to mention that I prefer to see

stretching under an anesthetic substituted by massage and manipulation given correctly and cautiously with the cooperation of the patient. The patient's pain is a useful guide for the operator and the results in stretching these muscles without an anesthetic are surprising. It may take a little longer to cause definite improvement but we avoid all the disturbances described and feared by Dr. Shorbe.

**Dr. John D. Currence** (New York): The conclusion of Dr. Shorbe that cases presenting prolonged symptoms following back injuries require very thorough anti-rheumatic treatment as well as local treatment is one that deserves special stressing. The general plan of treatment which he outlines is thorough and conducive to results. In view of the fact that foci of infection are so frequently found in chronic back disabilities, we have for some time attempted to reduce the incidence of these chronic cases by a preventative program of making general examinations to discover foci of infection at the time of the original injury, and all cases found to harbor clearly evident foci are put at rest and given constitutional as well as local treatment until an apparent complete recovery from the injury is accomplished. After this, they are advised relative to the removal or treatment of foci, with the explanation that otherwise they might be subject to rheumatism or other conditions which might arise as a result of their infection. The observations relative to the positive agglutinations for undulant fever, are very interesting but certainly hold little likelihood of specificity.

Dr. Shorbe states that vaccines are used more or less on a basis of shock therapy, so in view of the similar reaction produced by hyperpyrexia, which is so much more potent, it is unlikely that the vaccine has any material claim to credit in his results. In conclusion, I might add that we have been very enthusiastic about the use of mild hyperpyrexia in these cases as an adjunct to general medical and orthopedic care, but it is our opinion that hyperpyrexia of one to two hours with a mouth temperature of only 101 to 102 F. daily, for several days, if well tolerated, and almost always capable of repetition three times weekly, has proved definitely preferable to higher temperatures given less frequently.

\* This article appeared in the February, 1939 Issue, but due to lack of space discussion is herewith appended. — Ed.

# ARCHIVES of PHYSICAL THERAPY

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

## ∴ EDITORIALS ∴

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### AMERICAN HEALTH RESORTS AND THE PROFESSION

It is a problem for serious consideration that while to this day many spas, watering places and mountain resorts of Continental Europe enjoy extensive patronage, American resources of like nature which in some respects are even richer, are treated with indifference and left unexploited. Such an undesirable state of affairs must arouse the deep interest of physicians with visions beyond the immediate personal care of certain individuals who require for their well-being more than is attainable by modern therapeutic methods in most communities, large or small. When one takes into consideration that the United States has been greatly favored by Nature with facilities for the effective application of any and all known forms of natural climatic and hydriatic therapy, be it at the seashore, inland, or in mountainous regions, to which should be added an abundance of sunshine, then the question why these valuable resources have not been utilized to the greatest possible extent is one calling for a definite solution.

It may not be a pleasing statement to make, but it is a fact that to a certain extent organized medicine must be blamed for permitting these resources to remain in a state of innocuous desuetude. Nor can most of the blame be placed upon the shoulders of unscrupulous entrepreneurs who have improperly exploited the desire of many invalids and sufferers from certain chronic affections to obtain the surcease they know is assured in health resorts abroad. This by no means has any reference, either direct or indirect, to the comparatively few sanatoria or resorts utilizing certain natural remedial agents which are under the scientific control of specially qualified staffs. As a matter of fact even these do not enjoy the amount of patronage which they deserve. The reason for this is not hard to find once we critically analyze certain evils which the profession as a body has so far made no serious attempt to overcome. It has been observed that on frequent occasions the birth of a "spa" was ushered by the malodorous glamor of a well or stagnant pool, perhaps located in a marshy environment. A promoter exploits the mephitic odor by an advertising campaign with sensational claims and analyses, provides housing facilities and conducts the business of running a "spa" by methods which are a real stench in the nostrils of decent men, with the inevitable result of disillusion for the gullible sufferers. The number of such mushroom "spas" that have come and vanished is legion. Nor is it a secret that a number of widely advertised and well patronized hotels supposedly built around a natural well or quasi-medicinal bathing pool have extra attractions which have nothing in common with remedial aims. If such a hotel boasts of a resident physician, it is usually one willing to obey the wishes of the hotel manager, with the problem of administering the waters externally or internally being treated in a fashion devoid of any semblance of rationale. What wonder, then, that thoughtless laymen tar with the same brush the good with the bad and see the greenest grass on the other side of the fence.

Few physicians have extensive knowledge of the resources available in our vast land. While such institutions as Saratoga Springs, Warm Springs and Hot Springs have attained considerable popularity, other natural resources merit thorough investigation even for comparison with those in

Europe. For purpose of illustration attention is called to Sun Valley, Idaho, which in the past few years has been developed commercially and offers facilities for good scientific work. Advertised as a playground, it possesses facilities at least the equal of those obtained in certain regions of the Swiss Alps. Located in a valley of a high plateau, the grounds contain an abundance of natural hot springs in an environment of snow flooded with hot sun rays, so that one can inhale the purest of air in the open without need of clothing against the cold. Under proper scientific supervision such a resort could well prove a veritable Mecca for all sorts of sufferers. One of the shortcomings of many resorts that otherwise have considerable sanative merit is the failure to recognize the value of change of environment for the fatigued, the nervous and others who need diversion from the humdrum of life. Such resorts should be equipped to please both eye and mind, to provide facilities for rest, controlled exercise and recreation in addition to the natural remedial facilities they may possess.

It is precisely in such instances that whole-hearted cooperation between the proprietors and qualified members of the medical profession is sure to bring about an immeasurable amount of good. This is all the more desirable since the potential facilities offered in the United States are as varied as they are rich. Without going into details it must suffice to point out that apart from the thermal springs alluded to above, we have an abundance of material for brine baths, radio-active waters, sulphur baths, natural mud baths and the like for pelotherapy. These facilities should not be selected at haphazard, but advised in a rational manner to suit individual conditions. It will not be proper to send an individual with a cardiac affection to a resort whose agents are suitable solely for arthritis or some form of nephrosis, and vice versa. Nor is there any need at this stage of advanced civilization to clothe such resorts with an atmosphere of mystic powers. To illustrate the abuse in this direction mention is made of an incident narrated by F. Scholz in "Von Aerzten und Patienten," published in 1900. He visited a spa in order to spend some time with one of his classmates who was the medical director. Heated after a long walk, Scholz drank several glasses of the medicinal water for refreshment. The medical director who saw this upbraided him for "belittling" the water, since it was to be doled out to the spa guests in small "medicinal doses." There is no need for resorting to such methods bordering on quackery, for the natural agents are either effective or they are not, no matter what psychic influences one may attempt to exert on the ill.

An attempt to survey the situation under discussion has been made by a special committee of the Congress, whose report was published in the January issue of the ARCHIVES.<sup>1</sup> While this report presents certain interesting data it is far from laying any claim to being exhaustive. With the limited means at its disposal the committee could not possibly cover all existing legitimate spas and resorts let alone those that may well be considered as being anything else but health resorts and those of ephemeral existence. The entire problem, however, is of too great importance to the nation and the profession not to merit the most exhaustive investigation, to be followed by the initiation of badly needed reforms. Under our form of government, federal and state, little need be expected from the application of its police powers for such a goal. There remains as the only influential and authoritative representative of organized medicine, the American Medical Association, to bring about the desired results. Just as this national body has utilized its vast resources to secure standardization of medical schools and hospitals and to safeguard the public against fraud in pharmacotherapy and physical therapy, so it should and no doubt will obtain for our land the proper recognition due scientifically and ethically conducted spas, health resorts and climatic sanatoria. Once the American Medical Association has begun to separate the wheat from the

chaff, it will render the soil barren for the mushroom growth of "fly-by-night" spas and resorts. The American people have learned to regard the American Medical Association as the final authority on standards in any and all fields of medical practice and endeavor, and this body naturally is in a position to exert a strong moral influence even on such establishments that to this day use their so-called natural springs or pools as a mask to hide the actual allurements for patronage.

Time was when young physicians did not consider their training well rounded out until they had spent some time in European seats of learning. Today the roles have at least been balanced. Even specialistically trained physicians and surgeons abroad feel the need of visiting our land in order to become acquainted with our teaching centers, clinics and advances in the various disciplines of medicine. Since American medicine within the past few decennia has been able to achieve such universal recognition, there is not the least reason why it cannot secure similar recognition for the natural and inexhaustible riches available in our country as effective adjuncts to modern therapy. Meanwhile it is to the best interests of all physicians and surgeons to gain an insight into the nature and therapeutic effectiveness of all remedial agents provided by Nature.

#### Reference

1. McClellan, Walter S., Et Al.: Report on Spas and Health Resorts, Arch. Phys. Therap. 20:42 (Jan.) 1939.

## SCIENCE, NEWS, COMMENTS

### Physical Therapy Committee of the County of New York Reports Progress

A regular meeting of the Special Committee on Physical Therapy of the Medical Society of the County of New York was held in New York City, on Thursday, February 9, 1939.

Dr. John D. Currence, Chairman, reports that an outline was given of the progress made relative to encouraging the formation of courses for technicians as well as graduate study in the various medical schools of greater New York district.

A report was made by Dr. Kovács, chairman of the subcommittee on compensation cases, relative to a consideration of qualifications and standards for specialists with a physical therapy rating. The completed recommendations will be presented at the next meeting.

A discussion was held relative to cooperation in setting up standards for massage schools and standards for admission of students in hospitals where training is given. A special subcommittee consisting of Dr. Bierman, chairman, with Dr. McGinness and Dr. Kovács, was appointed to present the formulated ideas relative to such standards at the next meeting.

### Suggests Adding Vitamin B<sub>1</sub> to Candy and Liquor

Manufacturers of candy, white bread, refined cereals and sugar as well as alcoholic beverages should add thiamin chloride to their products as a health protective measure, Dr. Norman Jolliffe, New York University College of Medicine professor, suggested at a meeting of the New York Academy of Medicine.

Thiamin chloride is vitamin B<sub>1</sub>, which gives protection against nervous disorders.

It would be much better, Dr. Jolliffe pointed out, if people would get their necessary ration of this vitamin by substituting whole wheat bread and whole grain cereals for white bread and refined cereals and by cutting down on the annual per capita consumption of 100 pounds of vitamin-free sugar and vitamin-free alcohol. Failing this, he suggests the incorporation of enough of the vitamin in the vitamin-free foods to insure that each person gets enough in his daily diet.

A protest against the present vogue of "vitamin cure-alls" was made by Dr. Gilbert Dalldorf, director of laboratories at Grasslands Hospitals, Valhalla, N. Y. Dr. Dalldorf said that from the common sense viewpoint an "essential weakness of the practice is that those individuals able to afford a dollar a week for vitamin pills usually do not need them and those who might be benefited cannot afford them." — *Science News Letter*.



### Meetings of Physical Therapy Organizations

In this permanent column will be published information about meetings, election of officers, etc., of physical therapy organizations. New data should be sent promptly to the office of the Secretary, 2 E. 88th St., New York.

*American Congress of Physical Therapy*  
18th Annual Session, Hotel Pennsylvania, New York; September 5, 6, 7, 8, 1939; Dr. Richard Kovács, 2 East 88th Street, New York, Secretary.

*Special Instruction Seminar*, August 30, 31, September 1, 2, 1939, preceding 18th Annual Session, American Congress of Physical Therapy, Hotel Pennsylvania, New York. For detailed information see announcement elsewhere this issue.

*Eastern Section, American Congress of Physical Therapy*, under auspices of New York Physical Therapy Society, and the Pennsylvania Physical Therapy Association, Saturday, April 22, 1939, Jefferson Medical College, Philadelphia; Walter J. Zeiter, M.D., Secretary, Cleveland Clinic, Cleveland, Ohio. (See announcement elsewhere, this issue.)

*Pennsylvania Physical Therapy Association*; meetings at the Philadelphia County Medical Society Building, third Thursdays from September to June; Dr. Arno L. Zack, 216 East Broad Street, Bethlehem, Pa., Secretary.

*New England Physical Therapy Society*; meetings at Hotel Kenmore, Boston on third Wednesdays from October to June; Dr. William McFee, 41 Bay State Road, Boston, Mass., Secretary.

*Pacific Physical Therapy Association*; meetings at Los Angeles County Medical Association Building, fourth Wednesday. Clarence W. Dail, M.D., Sec'y., Treas., Loma Linda, Calif.

*New York Physical Therapy Society*; meetings on first Wednesday from October to May; Dr. Madge C. L. McGuinness, 1211 Madison Avenue, New York, Secretary.

*Kings County Medical Society, Physical Therapy Section*; meetings at 1313 Bedford Avenue, Brooklyn, bi-monthly on second Thursdays; Dr. H. T. Zankel, 5 St. Paul's Place, Brooklyn, Secretary.

### Pacific Physical Therapy Association

The regular February meeting of the Pacific Physical Therapy Association was held February 22, in the Presbyterian Hospital, 1322 N. Vermont Avenue, Hollywood, and the following program presented:

1. The Removal of Tonsils by Coagulation — *John Waite Avery, M.D.*
2. Surgical Tonsillectomy — *H. James Hara, M.S., M.D., Ph.D., F.A.C.S.*
3. Final Illness of George Washington — *Leland R. House, M.D.*

### Dr. Richard Kovács, Guest Speaker

The Norfolk, Virginia, County Medical Society had as its guest speaker on March 13, Dr. Richard Kovács, Clinical Professor of Physical Therapy at the New York Polyclinic and Medical School, New York City, and Consultant in Education of the Council on Physical Therapy of the American Medical Association, who spoke on "The Present Status of Physical Therapy in the Practice of Medicine."

### New Life-Saving Property Discovered in Hormone

New, life-saving power has just been discovered in a hormone that is primarily concerned with the life-creating process.

This fact, termed "amazing" by its discoverers, is reported by Dr. Robert Gaunt, of Washington Square College, New York University, and Dr. Harry W. Hays, of Princeton University. (*Science*, Dec. 16.)

Crystalline progesterone, the hormone that functions primarily to prepare the maternal body for child-bearing, can double for the life-essential hormone, cortin, to save lives threatened by disease or failure of the adrenal glands.

Cortin is a product of one part of the adrenal glands, the other part of the glands producing the more familiar adrenalin or epinephrin. Life cannot go on when these glands fail to produce cortin, as they do in Addison's disease, unless the deficiency is made up by giving the patient doses of cortin, just as diabetics get insulin to supply this deficiency of their own body.

Crystalline progesterone, Drs. Gaunt and Hays now report, will keep animals alive and healthy apparently indefinitely after total removal of the adrenal glands. Neither cortin nor salt need be given, if the animals get small daily doses of the progesterone.

Progesterone is not likely to take the place of cortin in treatment of Addison's disease sufferers, Dr. Gaunt said, because it is much more expensive. Only possible advantage of progesterone over cortin for such patients is the fact that progesterone can be obtained in chemically pure crystals, which is not yet possible for cortin.

The significance of the discovery that progesterone can double for cortin is not yet known. Dr. Gaunt said, however, that studies are under way now which he hopes will show what the discovery means in terms of body function and possible clinical application. — *Science News Letter*.



### Premature Aging Ascribed to Mineral Starvation

When an adult lacks vigor and becomes old before his time, he is probably suffering from long years of mineral starvation. This suggestion is made in the *Journal of the American Medical Association*. (Feb. 4.)

Lack of sufficient calcium and vitamin D in the diet is now known to be the reason why the bones of elderly persons become abnormally porous. "Senile osteoporosis" is the name physicians give to the general demineralization of the skeleton that is commonly present in elderly persons.

This condition over a period of many years may result also in pathologic changes in the kidneys and other vital organs and thus affect the general health, the medical journal declares.

Complete studies of mineral metabolism on normal or average persons in different age groups are recommended.

Too little effort has been made to understand or prevent the sicknesses that we have been accustomed to accept as an inevitable accompaniment of advancing years, the journal states. — *Science News Letter*.

### Brain Waves Used in Tracing Activity of Brain Centers

The chief regions of rhythmic activity of the brain can now be located roughly through science's latest researches upon brain waves, the electrical currents that originate in the human brain. Drs. H. H. Jasper and H. L. Andres, of Brown University's psychology department and the Emma Pendleton Bradley Home at Providence, R. I., have also used brain waves as pointers to defective and deteriorated parts of the brain not functioning as they should.

Not any closer to "reading minds" by brain waves, nevertheless science seems likely to use the new knowledge gained in understanding thought processes and in studying mental diseases.

The brain waves are not uniform throughout the whole brain, the investigators report. Two distinct types of brain waves, known to scientists as alpha waves and beta waves, have been studied. The alpha waves seem to predominate in the lower back part of the head, although under certain conditions some individuals show mostly beta waves in this region. The alpha waves are affected differently by light stimulation than are the beta waves.

In the normal person, alpha waves on the right side of the head are alike in frequency and amplitude to those in a similar region of the left side, although they may be somewhat out of phase, one lagging behind the other. This similarity is absent in a mental patient having one side of the brain diseased. Pictures of the electric waves led off the two sides of the brain of sufferers from brain injury, for example, following lead poisoning, showed a great difference between the activity on the two sides of the brain.

Brain waves of the other type, known as beta waves, are faster than the alpha waves. In any individual they have about twice the frequency and

half the amplitude of that person's alpha waves. They are more predominant in the area at the top of the head known as the Rolandic region. This is the part of the brain governing movement of the body. Occasionally outbursts of alpha waves are also found in this home of the beta waves.

In epileptic patients, the brain wave records during a seizure show what some scientists have likened to a "neurological thunder storm." Drs. Jasper and Andres have confirmed the finding that even when the patient is not undergoing a seizure, his susceptibility to them is betrayed by his brain wave record.

Sporadic seizure waves localized in the motor region of the brain, for example, when no seizure is present produce a similar pattern on the record paper to that seen in all parts of the brain during a generalized convulsion. The method of localized recording described by these authors permits the following of these seizure waves as they spread from one region of the brain to another. — *Science News Letter*.

### One of World's Worst Pains Relieved by Vitamin B Doses

Relief for sufferers from tic douloureux, a facial neuralgia so painful that some victims commit suicide, has been obtained by massive doses of vitamin B administered by a clinic conducted at California Institute of Technology.

Of 12 cases just reported to the medical profession, eight are free from pain and four are so free that the pain bothers the victims very little. The research is being conducted by Dr. Henry Borsook, biochemist, Dr. C. G. Wiggins, oral surgeon, and Dr. M. Y. Kremers, physician.

Ten times the amount of vitamin B required by a normal person is administered by mouth and by injection. In a month patients begin to feel relief from pains. In another month, there is marked freedom from pain. Some who have suffered shooting pains for 20 years obtain relief for the first time.

This nerve disease, one of the most painful ills affecting mankind, previously was curable only by brain surgery, with alcohol injection of the nerve the only palliative.

One of the present patients of the clinic was on the verge of ending her life when she was picked up by the police. Detective William Cropsey of Pasadena realized that the pain shooting through her face might be relieved at Caltech. He took her to the clinic and now she is enjoying more freedom from pain than she has known in years.

The clinic started in April when a sufferer from this spasmodic trigeminal neuralgia walked into the Institute's Kerckhoff laboratory and inquired if vitamin B treatments would cure the disease. Dr. Borsook, who in previous experiments had achieved good results in relieving neuritis, started this new research, using highly concentrated vitamins.

While astonishing results have been obtained, the medical men are not certain yet that the result will be permanent. However, they have no reason to be pessimistic. At the outset, they did not expect

to secure any results for six months or a year. They were agreeably surprised in getting noticeable improvement in a month.

The patients, ranging in age from 21 to 79, with the majority over 45 years, visit Caltech each day for treatment and all come together once a week at a clinic. Treatment is free with Caltech defraying the expense.

The experiments enable observers to make an ex-

cellent study of the physiology of pain. — *Science News Letter*.

### Errata

On page 80, February issue, "he is", line 5 should have read "they are"; on page 81 line 4 the word "studies" should have been inserted between the words "and" and "were".

## Discussion of the Papers of Drs. Harpuder, Kountz, Merrell and Sedwitz on Peripheral Vascular Disease

(Continued from page 170)

of the tissues. It demonstrates the appearance of metabolites in the tissues which act as vascular dilators, maybe histamine or something else which we don't know. If we produce reactive hyperemia by means of passive venous obstruction we have produced an anoxemia first. Put patients with peripheral vascular disease to complete bed rest to avoid the development of anoxemia by exercise. Then we should be careful to produce anoxemia therapeutically.

**Dr. William Bryan Kountz** (closing): There is a factor that has not been emphasized here to the extent that it should be, and that is, the consideration of the state of the tissue that one is attempting to treat. Since in all types of arterial disease, one has a loss of general tissue resistance which is not a local thing, but is general throughout the entire body, it is necessary to institute general therapy. Clinical experience would indicate that other factors, besides local improvement in circulation, may produce beneficial results in extremities with vascular disease. Hormones, especially, insulin, posterior pituitary substance, thyroid seem to have a beneficial effect on tissues in different types of vascular disease aside from increasing the blood supply.

**Dr. Paul Merrell** (closing): I believe I have nothing to add other than to make this statement. The prognosis seems to me to be a very important thing and I was very happy to hear Dr. DeTakats bring that point to your attention. Dr. Martin Fisher used to tell us that, "the hardest thing to do in medicine is to do nothing when it is the best thing to be done." It seems to me that this still holds good. While in this particular instance it means we probably cut off the leg, we have saved a lot of time and money, but if we recognize the fact that we are not going to do the patient any good by giving him a long treatment, then it is important to tell him as early as possible.

**Dr. Samuel Sedwitz** (closing): First let me tell you of an incident that occurred recently. We have in our clinic a Master Intermittent Venous Compression Unit. The pump portion of this unit is located in the basement. From here it is piped to the various rooms. This eliminates the noise of the pump, which is merely an ordinary

tire pump with 30 pounds of pressure. As the pressure diminishes the pump automatically starts; the tubing which leads to the Intermittent Venous Compression Cuffs comes from an interposed valve which controls the pressure, and a time clock at this point controls the intervals of pressure and relaxation. All patients are subjected to the same pressure and the same time intervals, namely, two minutes on and two minutes off. The average pressure which is applied to the patient, is 50 mm. of mercury.

One night the timing device stopped and the pressure remained at 50 mm. Fortunately only one patient was getting treatment at the time but unfortunately he developed an acute case of thrombophlebitis in his leg. I do not know how long the compression was on, probably for at least two hours. Therefore I am somewhat wary of trying out that persistent compression, especially in the presence of infection or varicosities with or without ulcers. I would be very reluctant to keep any vein compressed that length of time.

As to the benefits derived from the use of paraffin, we can say that we do not try to produce heat so much as to conserve the heat produced by other methods of treatment. In a clinic, such as ours, where patients are moved from room to room, across hallways, sent up in elevators and transferred to beds, they are exposed to frequent variations of atmospheric conditions. Also when covers are raised from the patient's bed, in spite of the presence of a thermostatically controlled vasculator (cradle), in order to give them a bath, bed pan or a urinal, they are further exposed to variations of atmospheric conditions. The door or window may be open. We try to prevent the presence of drafts. That is the main function in the use of paraffin, the prevention of sudden changes in the surface temperature. Of course, the presence of sustained heat in the tissues for a fairly long period of time is also of considerable value.

One thing we try to impress on patients and doctors alike, is to realize that when gangrene develops, there is only one thing left to do, that is to remove the dead parts and then give treatments to prevent further involvement. No form of physical therapy can restore life to dead tissue.

## THE STUDENT'S LIBRARY

**X-RAY AND RADIUM IN THE TREATMENT OF DISEASES OF THE SKIN.** By *George M. MacKee, M.D.*, Professor of Clinical Dermatology and Director of Department of Dermatology (Skin and Cancer Unit), New York Post-Graduate Medical School and Hospital, Columbia University; Consulting Dermatologist, St. Luke's Hospital, etc. Third Edition. Cloth. Pp. 830 with 380 illustrations, 31 charts and 2 colored plates. Price, \$10.00. Philadelphia: Lea and Febiger, 1938.

Few books deserve more fulsome praise than this, the third edition of MacKee's text on the use of radium and x-ray in diseases of the skin. Not only is it from the pen of a recognized authority, but to make "assurance doubly sure" he has surrounded the work with a group of collaborators whose reputation in the dermatologic specialty is readily accepted as of top ranking order. As a result of this unusual literary cooperation, the profession is presented with a treatise as timely as it is authoritative, as lucid as it is erudite, as practical as it is encyclopedic in scope. The artistic format — clear type, beautiful illustrations and the special enameled stock of the paper — indicates the generous interest and aid of a publisher who spared neither expense nor labor to present this work in a style most suitable as a background for the quality of this scientific contribution. One's interest is early captured even as one peruses the preface and its constructive and conservative attitude on the extent and limitations of radiotherapy in dermatologic diseases. MacKee points out that today in contrast to opinions in the past, "there is an increasing disposition on the part of dermatologists to employ x-rays only when necessary or when indicated; in other words with discriminating judgment." Whereas years ago many of the dermatoses were enthusiastically treated with x-rays, today because of greater experience, we have arrived at a view that its use is often limited in contrast to other procedures, or that it possesses special clinical values. Today the dermatologist knows when to be an externist and an internist, and thus avoids the many dangers associated with the use of x-ray and radium.

This edition shows that it has had the benefit of systematic and painstaking revision as well as the extra advantage of new material included, the work well balanced and brought down to date. The balance in scientific content is especially appreciated because the purely technical and clinical data has been well proportioned as indicated by the fact that about 15 per cent of the text is devoted to the physics of radium and x-rays; a similar amount to technic; 5 per cent to the biologic effects, and 5 per cent to the exposition of histopathologic changes. Approximately 55 per cent is given over to discussion of the special types of dermatoses

influenced by radium or x-rays. The final or 52nd chapter, contributed by a member of the bar and an authority in medico-legal affairs, must be regarded as especially valuable to those who routinely use x-ray and radium in their practice. It explains the legal regulations of medical practice, the relation between physician and patient, the procedures for defense against malpractice, and the like. The volume is richly illustrated and incorporates both an extensive bibliography after each chapter and a detailed index at the end. It is difficult to conceive how a more nearly perfect book on this subject could be written or one more timely.

**PHYSICAL THERAPY: THEORETICAL AND CLINICAL.** By *Joseph E. G. Waddington, M.D., C.M.* (Bennett), with an Introduction by *Walter J. Turrell, M.D., D.M., B.Ch.* (Oxon.), D.M.E.R. (Contab.), Physician in Charge of the Physiotherapy Department, Radcliff Infirmary, Oxford, etc. Cloth. Pp. 489 with 274 illustrations. Price, \$5.50. St. Paul and Minneapolis: Bruce Publishing Company, 1938.

The title and pleasing format of this volume suggest that an original contribution is herewith presented, but perusal of the contents points to the fact that the greater part of the exposition including illustrations have been bodily transposed with slight revisions from an older text of the author, entitled "Practical Index to Electro and Phototherapy." The work as a whole is in many instances an improvement over the previous edition, but should be catalogued as a revised and enlarged product as a courtesy to a source to which it is heavily obligated. Throughout the volume one encounters a defensive and perhaps a rather sensitive attitude in support of physical therapy, directed against a so-called callous and skeptical profession. The book abounds in preachments and platitudes and is presented in a style the English of which may best be described as Waddingtonian in its over-reaching use of the adverbial adjective. To cite one example of his stylistic individualism: "Physical therapy, with all that such a comprehensively inclusive term rightly aggregates, leaves absolutely nothing of value for the imperfectly trained, licensed or unlicensed enthusiast to restrictedly and ignorantly extol at the expense of an adequately trained medical profession. False doctrines only command receptive attention of or when the true and tried be lacking in authoritative and judiciously zealous adherents and proponents" (page 23). His sincerity and enthusiasm for physical procedures unfortunately have developed a faith out of bound with fact and experience, evidenced by his support of many methods that are still regarded as unscientific, fantastic or metaphysical. Thus the book not only presents an acceptable survey of low and high fre-

quency currents, the physics, diagnostics and therapeutic application of the galvanic current, static and phototherapy, but also contains much that is uncritical, unauthentic and unauthoritative. Among the facts that are unauthentic, it is noted that credit is frequently given where credit is not due; for instance (page 49), the author attributes to the late Dr. Grover an illustration of a classic word picture on electrolytic solution that originated with Sir Lewis Jones and was quoted by the late Dr. Massey in his own text. He supports his own convictions with laborious arguments regarding the unscientific practices of the much condemned Ellis contraption for "determining different disease conditions by means of electric currents of selective frequency." In defense of his championship of a procedure that was sharply criticised by the *Journal of the American Medical Association* and others, Waddington advances arguments that only by widest implication have any reference to his thesis. At best they are specious and smack of pure sophistry. As an example of assertions that are definitely uncritical, one must in the interest of safety warn the profession not to use the vaginal and rectal electrodes advocated on page 196, because of their tendency to produce dangerous hot spots and burns. Accordingly, if one evaluates the book from the standpoint of its assets and liabilities, one comes to the conclusion that the author has presented an exposition on the theories, practice and biophysical nature of the galvanic, low and high frequency currents, as well as on the therapeutic uses of static electricity, photo- and actino-therapy. It is to be regretted that a great deal of space and argument have been devoted to subjects definitely unworthy of the author's ideals and reputation as a student of physical therapy.

**ENDOCRINE THERAPY IN GENERAL PRACTICE.** By *Elmer Severinghaus, M.D., F.A.C.P.*, Professor of Medicine, University of Wisconsin; Editor, Department of Endocrinology, the Year Book of Neurology, Psychiatry and Endocrinology. Cloth. Pp. 192 with 39 illustrations. Price, \$2.75. Chicago: The Year Book Publishers, Inc., 1938.

The subject of endocrinology has in the past been the battleground of a great deal of speculative assertions as well as extensive contributions of definite promise. Among the latter one encounters a maze of physiologic facts and theories that suggest the presence of actual therapeutic possibilities as significant as clinical pharmacotherapy in other fields. The data and the detail of the past contributions have been so encyclopedic that much of this information would be a closed book to the majority of practitioners were it not for the timely assistance rendered by a work such as above provided by Severinghaus, an authority on endocrinology. The volume presents a concise and well correlated exposition on the practical import of clinical endocrinology and attempts to act as a guide to the prescription of those potent products derived from the glands of internal secretion. It aims to assist the physician by directing his attention toward the best diagnostic methods and

most dependable therapeutic glandular products in relation to his clinical problems, as well as to broaden his orientation on the subject even though what is said in these pages may be soon outmoded because of the rapid developments in this field. One senses from the lucid style and conservative attitude that the author has in the back of his exposition the dual objective of debunking it from imaginary attributes and placing the data before the readers in as clear a diction as is consistent with the facts. Each of the 14 chapters has a definite message. For instance, the first chapter evaluates the mysterious qualities of the hormones and explains their action by striking examples as a fundamental effect of catalyzers and correlators. Chapter two reviews in semi-outline form the present state of our knowledge about systemic endocrinology, which in turn paves the way for the more detailed exposition in the succeeding chapters regarding the function and clinical control of the factors associated with anterior pituitary disturbances; the pathologic problems related to thyroid dysfunction; the parathyroid; the pancreas and diabetes mellitus; the adrenals; the ovaries; the testes, and obesity. The book is replete with practical suggestions and information of prime value to the clinician. It not only has presented the authoritative facts but has so organized them as to render clear the extent and present limitations of endocrinology. Accordingly, the work is enthusiastically endorsed as a timely and practical contribution and recommended to the profession.

**THE RHEUMATIC DISEASES: A COURSE OF LECTURES BY THE MEDICAL STAFF OF THE ST. JOHN CLINIC AND INSTITUTE OF PHYSICAL MEDICINE.** Edited by Sir *Leonard Hill, M.B., LL. D.*, Director of Research, St. John Clinic and Institute of Physical Medicine, and *Philip Ellman, M.D., M.R.C.P.*, Physician to St. John Clinic and Institute of Physical Medicine, London. With a foreword by Sir *Arthur MacNalty, K.C.B., M.D., F.R.C.P.*, Chief Medical Officer of the Ministry of Health. Cloth. Price, \$4.00. Pp. 270 with 46 illustrations. Baltimore: William Wood & Company, 1938.

This volume brings together within a small compass a practical presentation of the modern conception of the rheumatic diseases. It consists of a collection of lectures given to a post-graduate course at the St. John Clinic and Institute of Physical Medicine. The authors believe that the experience in the treatment of tuberculosis shows a close analogy between this disease and chronic arthritis. There is a general constitutional as well as a local disturbance in both groups of diseases and the time factor in their treatment is of necessity a prolonged one. They believe that as the treatment of tuberculosis is undertaken in specialized institutions and clinics under the control of the State, so the rheumatic diseases also require such specialized institutions where rest, exercise, diet and all methods of physical medicine would be readily available. Today it is generally conceded that the rheumatic syndrome is one of the major problems best controlled by physical therapy and of interest to every spe-



cialty in medicine. The scope of the exposition broadly reflects the many sided views of its management. Thus, there are several chapters of great interest to those using physical agents in the treatment of these diseases. Taylor has contributed a cogent chapter on the physical basis of physical medicine; Sir Leonard Hill critically reviews the physiologic action of methods used in physical medicine; Eidinow discusses the indications for light therapy in rheumatic diseases and the technic of treatment by local and general ultraviolet radiation of the skin; Bach has evaluated the clinical possibilities of hydrotherapy for the many symptoms classified under the generic term of rheumatic disease. The volume can be highly recommended.

**THE FUNDAMENTALS OF INTERNAL MEDICINE.** By *Wallace Mason Yater, M.S.* (in Med.), M.D. Professor in Medicine and Director of the Department of Medicine, Georgetown University School of Medicine; Physician-in-Chief, Georgetown University Hospital, etc. Cloth. Pp. 1021 with 255 illustrations. Price, \$9.00. New York, London: D. Appleton-Century Company, 1938.

The title and contents of this work correctly indicate the purpose and successful completion of a text for students and practitioners in the form of an intermediary treatise between existing formal tomes and monthly publications on the fundamentals of internal medicine. Yates feels that there is a definite need for a contribution that would encompass this field and present the essentials in a style neither too technical nor overly formal but sufficiently detailed so far as concerns the problems of symptoms, diagnosis, treatment and classification encountered by medical students and general practitioners. To this end the author has contributed a well formulated and voluminous exposition on clinical medicine, which emphasizes the most important facts that one should have at one's finger tips as a foundation upon which the superstructure of more detailed and extensive knowledge may be built. For this purpose the author enlisted the cooperation of eleven collaborators whose reputation in their respective fields are so well known as to lend authority and authenticity to the sections which they undersigned. The fact that the problems of internal medicine frequently overlap into other specialties has often disclosed a certain "no-man's land" in practice which has been indifferently treated in many books. One notes that the author has courageously met this issue, and correlated these borderline problems as a part of general practice. Hence one finds here detailed expositions on such practical topics as affections involving the eye, ear, nose, throat, and the like. In spite of this extra scope, the work is extremely well organized into 21 compact sections with suitable subheads and bold face type. The discussions tend toward the side of brevity, but are nevertheless lucid, practical and stylistically easy to read, so that it veritably represents an exhaustive exposition of reliable information on the fundamentals of internal medicine. Of the twenty-one listed sections, ten were written by Yater alone, four in collaboration with others and seven by collaborators independent of

the author. Included is a comprehensive but critical section on dietetics, a well selected bibliography and an index that fully covers the needs of this work. Accordingly one feels that the author has presented a practical contribution of value to both students and clinicians.

**REPORT ON RADIUM BEAM THERAPY RESEARCH 1934-38.** By *Constance A. P. Wood; L. G. Grimmett; T. A. Green and others*, under the direction of the Governing Body of Radium Beam Therapy Research. Paper. Pp. 77. Price 4s. Od. (postage extra). London: His Majesty's Stationery Office, 1938.

To all intents and purposes the subject matter may be accepted as an official report compiled under the auspices of the British Medical Research Council, which is reflected also in the rather reserved diction of the text. However, this should not be interpreted as in any way detracting from the informative and scientific value of the contribution but rather as enhancing authenticity. Essentially this is a report of four years experience with a method known in the United States and other countries as "teleradium therapy." The favorable results reported in other countries with this method have caused the British authorities and certain learned bodies to borrow from Belgium a large quantity of radium needed for this type of radiotherapy and to undertake an extended study of its possibilities in the treatment of malignant growths of the mouth and throat, chosen for their easy accessibility. On a fairly large clinical material which is statistically grouped and evaluated in the report, the results obtained are summarized as "promising." Of no less scientific value is that part of the text which treats of the organization of the personnel, the equipment and the methods employed to safeguard the health of the physicians in charge. The book, therefore, has the dual value of presenting organizational as well as clinical data. There are numerous photographic illustrations, diagrams, charts and tables and 14 reproductions in natural colors of aquarelles showing cancer of the tongue and of the larynx before and after treatment with the teleradium method. This small but weighty monograph should prove of value to all interested in cancerotherapy and particularly those who specialize in radium therapy.

**MALIGNANT TUMORS OF THE SKELETAL MUSCLES, FASCIAE, JOINT CAPSULES, TENDON SHEATHS AND SEROUS BURSAE.** By *Gunnar Jönsson*. Paper. Pp. 304. Price, Swed. cr. 20. Stockholm: Kungl. Boktryckeriet. P. A. Norstedt & Söner, 1938.

This is another monograph issued by members of the staff of the Radiumhemmet as a supplement (No. 36) of the *Acta Radiologica*. It is a carefully thought out scientific report on the experiences gained in the treatment of malignant tumors of the type indicated in the title, both with regard to the arrangement of the subject matter and its presentation as a text. Apart from the usual regional grouping there are chapters devoted to pathology, prognosis, diagnosis and histology, while the clinical



presentation proper, which is interspersed by 112 case histories, offers at considerable detail the observations made by the author and the specialists of the institution with regard to the results obtained from treatment by radiation alone or in combination with surgery. At the end there is a large summary of the entire volume of more than 7 pages, followed by no less than 17 pages containing closely printed references arranged according to the names of the authors in alphabetic order. The numerous preceding supplements published as independent monographs are so well known for scientific exactness and splendid scholarship that it need but be stated that the present monograph is a worthy successor to convey an idea of its excellence and scientific value. In fact it represents a rather exhaustive contribution to the clinical studies of malignant neoplastic disease of the skeletal, muscular and articular apparatus.

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SHORT WAVE THERAPY. THE MEDICAL USES OF ELECTRICAL HIGH FREQUENCIES. By Dr. *Erwin Schliephake*, Dozent at the University of Giessen. Authorized English Translation by *R. King Brown*, M.D., D.P.H., from the third German Edition, with a Foreword by *Elkin P. Cumberbatch*, M.A., M.B., B.Ch. (Oxon.), F.R.C.P. (Lond.), D.M.R.E. (Camb.). Second English Edition. Cloth. Pp. 296 with illustrations. Price 21/net. London: The Actinic Press, 1938.

Schliephake's reputation as perhaps the earliest and most provocative of contributors in clinical short wave radiation has become so widely recognized that no single language is today ample to cover his international following. It was therefore consistent with the demands that his book be translated into the English language in order to acquaint the largest number with the facts and theories of one who initiated its application and technics in clinical medicine. Unfortunately much of its artistic format was lost in the translation from the original, so that viewed in its second English revision it lacks, despite many improvements, the vitality and the intangible qualities woven into the German text. It is undoubtedly true that part of the fault lies in the inartistic mechanical inferiority of the paper and printing, part to the editor's efforts to translate his material too literally and idiomatically, and finally to the fact that the discussions resemble the echo of thoughts so frequently repeated as to create an impression of familiarity with views already old. Such a situation naturally dulls the interest of old readers and to a certain extent retards the en-

thusiasm of potential students in an exposition that is historically one of the most original in its field, and clinically outstanding for its inspirational and thought provoking qualities. Schliephake's views have been the battle ground and source reference for practically every contribution on short wave therapy, hence the widespread familiarity with his utterances is an extraordinary compliment in recognition of his original labors. His preface to this edition not only tersely reviews the present status of short wave practice, but adopts, unfortunately, a certain caustic tone that is suggestive of chauvinism. Apparently he resents to have his name associated with the one of an unnamed "prominent person" who might have been technically or historically the very background from which modern high frequency therapy developed. One feels that it would have been in better taste to have had the utterance quoted below come from the pen of one other than himself; namely: "As a curiosity I may mention the attempt to associate this new therapy with the name of some prominent person. This 'honor' appears all the more devoid of taste if the person concerned has nothing whatever to do with the attempt." Had someone else voiced the above opinion in his defense it would have been possible in the interest of historic fact to name a name instead of creating implications under unpleasant innuendoes.

In general the volume has had the added benefit of extra revision, an enlargement by approximately 50 extra pages, the addition of an extra chapter by Rhode on the technical and mathematical relation of short wave energy to its clinical application—an appendix as clinically comprehensive but impractical as in our vermiform biologically—, and a satisfactory index. Cumberbatch's foreword contains all the amenities necessary for a friendly and benignant introduction, and points out that the translation is lucid, that there is no general agreement in regard to the mode of action of short waves, and that while most English workers believe that the biologic changes are due to heat alone, there is food for thought regarding the action of this current on colloidal molecules and molecular complexes. What is most disquieting from the pen of such a student is that as late as last year, and this in the face of published reports reflecting authority, he states that the difficulty of short wave treatment is still to be overcome by a reliable method of dosage measurement when actually such now is obtainable. In general, the second translated English edition adds to the reliable and informative contributions on short wave therapy and is recommended to the profession.

# INTERNATIONAL ABSTRACTS

## **New Experimental Data on Artificial Hyperthermia. A. Bessemans.**

Ann. Int. Med. 11:1933 (May) 1938.

Bessemans reviews the problem of artificial fever induced by long and short wave diathermy. He points out that the major factors involved in control of syphilis is an exact technic to produce systemically prolonged heat in conjunction with a chemotherapeutic régime. The following conclusions are drawn from the new experimental data introduced in his report. The deep temperature created depends on the position of the electrodes during local diathermization of the abdominal organs. To avoid high frequency field influence one should use quartz or glass thermometers filled with benzene or mineral oil. It is pointed out that there is a difference "in vivo" in the thermo-resistance of the *Treponema pallidum* of the external syphilitic lesions of rabbits and man compared with the treponemas found in the lymph glands of syphilitic rabbits. In the latter case the thermoresistance is so great that it surpasses that of the organism of the host. Neither the wavelength nor the physical modality used has any effect per se on killing the *Treponema pallidum* within the tissues. The important factor is the height and duration of the temperature of the lesion. The healing effect must be considered in the light of the temperature variations which exist in various parts of the animal body. Paradoxical and unexplained results after treatment with diathermy occasionally occur in rabbits. This is a sign of the reaction of the animal organism as a whole. If bacterial cultures, treated "in vitro" with intense short or ultra-short wave radiation, are cooled so that no heating effect results, they are not affected. The same fact applies to emulsions of an Ehrlich sarcoma of the mouse, and to trypanosomas. A judicious use of the combination of chemotherapy and pyretotherapy seems to be more effective in the syphilitic rabbit than when either therapy is used alone. Serological tests for syphilis are valueless criteria in judging the presence, the progress or the persistence of the disease in rabbits.

## **Individual Variations in Response to High Temperatures. R. A. McCance.**

Lancet, 240:190 (July 23) 1938.

Individual variations in response to high temperatures provide an explanation of the different ways in which people working in hot atmospheres or living in hot climates react to their surroundings. Some never suffer from the major symptoms of salt deficiency, while others who continue to lose considerable quantities of salt in their sweat, are very likely to suffer unless

they are provided with a generous intake of sodium chloride. There is another variable among subjects but over this one can exercise no control. Some persons undoubtedly show signs of deficiency more quickly than others for a given loss of salt.

## **Hemorrhoidectomy With High Frequency Electric Current. Ernest E. Arnheim.**

Am. J. Surg. 41:45 (July) 1938.

Hemorrhoidectomy with the high frequency electric current has been performed in 189 patients. There were no deaths or postoperative strictures, but hemorrhage on the third postoperative day occurred in one of the early cases. Regular proctoscopic examinations were carried out in a follow-up period of one to six years in 156 patients, and in this group two recurrences of internal hemorrhoids were found. These recurrences, however, were small and gave no symptoms.

## **Short-Wave Therapy in the Pelvis. John R. Evans.**

Rocky Mountain M. J. 35:543 (July) 1938.

Evans points out that short wave treatment in pelvic infections produced favorable results when he employed as rigorous a control as was clinically possible. He used the same wavelength and time of treatment. The apparatus in question was one having a 25-meter wavelength with which continuous coils were alternately wound anteriorly and posteriorly. Two treatments of twenty minutes each were given per day for eight to ten days, with no additional therapy except symptomatic relief of distress. The treatment of gonorrheal salpingitis by this method produced apparent cures in cases of acute infections where this was started early and in which there is no complicating retroversion. Palliation was obtained in the chronic recurrent cases in acute cases which presented themselves late, and in acute cases with retroversion even though treated early.

## **Significance of Porphyrin Content of Urine in Dermatoses Associated With Sensitivity to Light. Albert R. McFarland, and William H. Strain.**

Arch. Dermat. & Syph. 38:727 (Nov.) 1938.

In the group of dermatoses in which photosensitivity is present, it has been impossible to find its cause. In the rare condition hydroa aestivale with congenital porphyrinuria, however, it seems probable that the cutaneous manifestations are due to sensitization produced in the lower organisms, in animals and in man by the injection of porphyrins prior to exposure to sunlight.

Studies were therefore undertaken to determine the excretion of porphyrin in a variety of dermatoses in which there clinically seemed to be light sensitivity. With this in view, observations were made on the level of excretion of ether-soluble porphyrins in the urine of persons with a variety of dermatoses, most of which had a photosensitive aspect. The method used was perhaps the most efficient for determining the output of coproporphyrin in the urine in patients affected with a variety of cutaneous diseases.

The excretion of porphyrin in the majority of cases studied was within normal limits. Of special interest to the dermatologist, however, are the following findings: (1) A patient with hydroa aestivale and congenital porphyrinuria showed high values. (2) A patient with xeroderma pigmentosum, which superficially resembles hydroa aestivale with congenital porphyrinuria, had a normal excretion. (3) Several patients who had taken sulfanilamide without cutaneous reactions and one who was sensitive to light showed normal values. (4) A patient with arsenical exfoliative dermatitis showed a high value. (5) A patient with sunlight urticaria had a normal value.

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**Prevention and Treatment of Neurosyphilis By Combined Artificial Fever and Chemotherapy.**  
**A. E. Bennet, and Murray D. Lewis.**

*Am. J. Syph., Gonorr. & Ven. Dis.* 22:593 (Sept.) 1938.

The authors assert that with the proper dissemination of present therapeutic knowledge of syphilis, it is almost that the late manifestations of neurosyphilis could be prevented. Routine cerebrospinal fluid studies within the first year of the infection make the diagnosis in the asymptomatic stage of neurosyphilis. From this group, clinical neurosyphilis develops. The progression of these spinal fluid findings determines the type of therapy indicated and also gives a lead as to prognosis. In asymptomatic neurosyphilis not responding to routine chemotherapy, some form of fever therapy should be given, since accumulated clinical evidence shows that fever therapy in this stage adequately protects against neurosyphilis. In 10 cases here reported, of late asymptomatic neurosyphilis treated by combined artificial fever and chemotherapy, strongly positive cerebrospinal findings were completely reversed in 7, partially reversed in 2, and unchanged in 1. In 19 patients with paralytic dementia, treated by combined artificial fever and chemotherapy, complete remission with full occupational recovery followed in 14, moderate improvement in 3, and no improvement in 2. In 31 cases of tabes dorsalis, of the most severe type, many with resistant chronic symptoms, 16 (52 per cent) had complete relief of all the predominating symptoms, 11 (35 per cent) had improvement in all predominating symptoms, with disappearance of some of them; while only 4 (13 per cent) were unimproved. Neuritic pains were definitely benefited or relieved in 24 out of 28 patients. Gastric crises were completely or partially relieved in 11

out of 15 cases. In both groups the patients benefited were often therapeutic failures by other methods, physically debilitated or elderly. Ataxia and urinary incontinence also responded to fever therapy in many of these cases. There was no success, however, in the 3 patients with Charcot joints. In 12 patients with severe disabling types of meningovascular neurosyphilis, 10 got complete relief of the predominating symptoms, 1 was benefited to some degree, and 1 was unimproved. The serologic results did not parallel clinical improvement. Occasionally spinal fluid reversals were seen in patients only slightly benefited, while the reverse took place more often.

The authors therefore conclude that (1) combined artificial fever with chemotherapy is the indicated method of treating resistant asymptomatic neurosyphilis, as well as the safest and most effective way of managing severe grades of clinical neurosyphilis. (2) While the value of fever therapy in neurosyphilis is undisputed, the evaluation of various types of fever therapy will be made finally by comprehensive studies such as that which the United States Public Health Service and Cooperative Clinical Group are carrying out.

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**An Inexpensive Portable Electric Thermometer for Hyperpyrexia Clinic.** Francis W. Bishop.  
*J. Lab. & Clin. Med.* 24:181 (Nov.) 1938.

In routine hyperpyrexia it is desirable to employ some type of continuously indicating thermometer. This is especially true in the case of prolonged fever treatments (ten to twenty-four hours). The use of such an instrument spares the patient a great deal of trauma, and, on the whole, greatly facilitates the accurate administration of the fever. Bishop constructed a suitable instrument at the lowest possible cost, and describes a resistance thermometer unit which may be duplicated in most laboratories for \$75.00. One of the principal difficulties was to find a galvanometer of the necessary accuracy and sensitivity which was not too expensive. This has been well met in the G-M No. 2562-B pointer-type d'Arsonval galvanometer, costing \$20.00.

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**Chronic Progressive Deafness, Including Otosclerosis and Diseases of Inner Ear.** George E. Shambaugh, Jr.

*Arch. Otolaryng.* 28:780 (Nov.) 1938.

Landry applied ionization (previously used in the treatment of suppurative otitis media) in cases of deafness in which the drum membrane was intact. The author asserts that experiments have shown that the ionization penetrates not only into the middle ear but into the inner from the external auditory canal. A solution of iodine ions is used for adhesive otitis, of calcium ions for otosclerosis and of silicon ions for dry otitis. The coincident use of high frequency diathermy is of value and also is of psychologic benefit. The results in cases of chronic adhesive otitis are better than 6 of 10 patients benefited. In cases of chronic catarrhal otitis the results are

even better. In most cases of otosclerosis the tinnitus is diminished; the hearing is improved in one-third of the cases in which the condition of the labyrinth is good. (Shambaugh comments: While difficult to disprove without repeating the work, this and the previous articles on the medical treatment of otosclerosis are even more difficult to believe.)

**Benign Tumors of the Larynx. Gordon B. New, and John B. Erich.**

Arch. Otolaryng. 28:841 (Dec.) 1938.

Two methods are generally employed by New and Erich for eradication of these tumors: (1) excision by use of laryngeal forceps or a scalpel and (2) destruction by diathermy (electrocoagulation). In general, radium and roentgen rays have little place in the treatment of benign laryngeal tumors. Diathermy, when used, should not be carried out too vigorously; in the treatment of a benign tumor there is no need of destroying large amounts of normal tissue, which might result in stenosis or at least in impairment of the quality of the voice. Severe dyspnea should receive prompt attention before treatment of the tumor. With few exceptions, all benign tumors of the larynx should be removed, not only because they interfere with phonation and obstruct the larynx but because of the possibility that a few of them may become malignant. At the present time, no one treatment for papillomas of the larynx is entirely satisfactory. In spite of any form of treatment, these tumors particularly in children, tend to recur. Many methods, both surgical and medical, have been and are being used in the treatment of this condition, and each method has its staunch supporters. For the past few years diathermy (electrocoagulation) has been used almost entirely by the authors in the treatment of papillomas. By using a small amount of current, which is carefully controlled, each individual papilloma can be lightly touched with the active electrode. This method quickly destroys the tumor without affecting the underlying tissues. It has the advantage of being a bloodless procedure, which allows clearer visibility of the field of operation. Transplantations are not as likely to follow electrocoagulation as avulsion. No cases of scarring of the larynx followed diathermy nor that in which the voice was disturbed.

**Relief of Pain in Laryngeal Tuberculosis. V. Cotton-Cornwall.**

Lancet 235:1109 (Nov. 12) 1938.

Ionization by electrical anaesthesia has given the author the most satisfactory results. The current is produced by a 45-volt dry battery and controlled by a reducing coil and a milliammeter. The electrodes are of malleable conducting metal, the anterior electrode being 3 by 1½ inches wide, the posterior 4 by 1½ inches wide. They are covered with layers of lint at least ½ inch thick when wet, which overlap the edge of the metal-

lic electrode. One electrode is soaked in pure water and connected with the positive pole. The negative electrode is placed over the larynx and the positive over the nape of the neck, and held in position by elastic bands. The intensity of the current is uniformly 10-12 ma. It is best to begin with 4-5 ma. and only to go cautiously above 9 ma., for there is danger of burning the skin, especially if the pad does not completely cover the metal as described above.

Applications last for half an hour each and are repeated daily until the anaesthesia lasts twenty-four hours, after which they are repeated when the pain recurs. There is no advantage in daily applications when the anaesthesia lasts forty-eight hours. As soon as the current passes, the patient notices a sensation of stricture in the neck and at the same time an inky or coppery taste in the mouth, accompanied by increased salivation. The feeling of stricture passes off in four or five minutes, but the taste and the salivation persist. The pain is usually abolished at the end of fifteen minutes. The patient is free from pain for twenty-four hours or more after 6-7 applications, and then occasional applications (once a week or every other week or at even longer intervals) will maintain this relief. No claim is made that the treatment is curative, but considerable healing has taken place in two cases, in one at least in spite of extensive and advancing pulmonary disease.

**Value of Fever Therapy in Sulfanilamide-Resistant Gonorrhea. C. A. Owens; Willis D. Wright, and Murray D. Lewis.**

J. Urol. 40:847 (Dec.) 1938.

The introduction of sulfanilamide as a successful chemotherapeutic agent in gonococcal infection has necessitated a re-evaluation of the place of artificial fever in the treatment of this disease. One of the author's (C. A. O.) in 1936, reported a group of 100 cases of gonorrhea treated by artificial fever. He concluded that prompt and dramatic relief of gonococcal arthritis and epididymitis could be promised in every instance and that 81 per cent of patients with all types of gonorrhea could be cured by an average of 4 to 6 treatments, each of 6 hours duration at 106-107 F.

The present status of treatment of gonorrhea with reference to sulfanilamide and artificial fever, therefore, appears to be as follows:

1. In view of the reports in the literature, every case of gonorrhea should first be given sulfanilamide alone, using adequate dosage with all the accepted precautions against intoxication.

2. If this fails, there are several alternatives: (a) Fever alone, a single 10-hour session at 106-107 F. will cure 80 to 90 per cent of these sulfanilamide-resistant cases; (b) Combination of sulfanilamide in adequate dosage with a 10-hour fever session at 106-107 F. may be tried and will probably cure close to 100 per cent of cases.

3. At present artificial fever therapy is still the treatment of choice for gonococcal complications.



**Transurethral Prostatic Resection. Edward N. Cook.**

Tri-State M. J. 10:2095 (July) 1938.

Cook advocates for spinal anesthesia as the method of choice. More than 100 mg. of procaine never should be used and, in the majority of instances, 70 mg. will be enough. Intravenous administration of pentothal sodium of caudal anesthesia occasionally is indicated. The choice of instrument employed and the technic used will vary with different transurethral operators. There is, perhaps, not much difference between the results obtained with the various methods, although the criticism frequently is made that electrocoagulation incident to operation will produce wider destruction of tissue and, consequently, greater febrile reaction and more dysuria post-operatively than when excision of tissue is carried out with the cold knife.

The amount of tissue removed will vary with the size of the obstructing portion of the enlarged prostate gland. In approximately 25 per cent of cases, removal of 10 Gm. of obstructing tissue, or less, will eliminate the presence of residual urine and allow free and easy urination. Ten per cent of patients require removal of 50 Gm. of tissue or more, and 65 per cent have an enlargement requiring excision of 10 to 50 Gm. The average amount of tissue removed transurethraly has been increasing with the added experience of the operators and, at the Mayo Clinic, is now 20 to 25 Gm.

**Limiting Factors in Photosynthesis: Light and Carbon Dioxide. Emil L. Smith.**

J. Gen. Phys. 22:21 (Sept. 20) 1938.

Extensive measurements have been obtained (a) relating photosynthesis and light intensity for a large range of CO<sub>2</sub> concentrations and (b) relating photosynthesis and CO<sub>2</sub> at different light intensities. From these families of curves, the limiting factor relationship can be secured for any value of the photosynthesis rate. In terms of previous work an equation has been derived for describing these relations between the intensity and CO<sub>2</sub> concentration necessary to produce a definite amount of photosynthesis. This equation furnishes an exact description for all the data, except those for low rates of photosynthesis where a slightly different equation is required. The nature of the two equations suggests that a simple first order reaction determines

the velocity of the light process at low photosynthesis rates, but that at high rates the mechanism is complicated by another factor.

**Treatment of Carcinoma in the Pharynx and Larynx and Its Results. L. Colledge.**

Brit. M. J. 2:167, 1938.

Removal by diathermy is suitable for early carcinomas of the oropharynx with no palpable nodes in the neck. More advanced infiltrating growths require extensive mutilating operations and a careful reconstruction is necessary later. Unfortunately it is doubtful whether irradiation is sufficiently successful to supplant surgery. Biopsy provides an important guide to treatment because sarcoma and grade IV carcinoma give uniformly bad results with surgery but are radiosensitive.

Early tumors on the lateral wall of the larynx, the epiglottis, the aryepiglottic fold and the post-cricoid area may be treated by lateral pharyngotomy followed by a plastic operation. More advanced growths in the same positions, as well as tumors in the fossa pyriformis, almost always need pharyngolaryngectomy and a somewhat elaborate plastic operation later. In the author's series of 39 pharyngotomies, 13 patients were well for more than three years and 5 for more than eight years. Pharyngolaryngectomy was performed on 16 patients; 6 were well for more than three years and 2 for more than eight years. In the past the success of irradiation in this class of cancer has been negligible.

Intrinsic cancers of the larynx require laryngofissure or partial laryngectomy or else total laryngectomy, according to the position and extent of the growth. The author's results were as follows: among 23 patients who had laryngofissure or partial laryngectomy, 18 were well for more than three years and 9 for more than eight years; among 75 who had total laryngectomy, 45 were well for more than three years, 18 more than eight years, and 3 more than fifteen years. Irradiation has been most successful in this group and is an attractive alternative to mutilating operations, but it has not yet been established that a high percentage of good results can be obtained.

The results for private and hospital patients are given separately in addition to the totals quoted above. The results in private practice were much superior, owing to the better general and dental condition of the patients and to the better circumstances of treatment. — [Abstr. Am. J. Can. 35:295 (Feb.) 1939.]